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**THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION**

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## NOTES AND COMMENTS.

### Teeming Speeds.

In all large modern steelworks there exists in the steelworks manager's office a comprehensive table, which enunciates the speed, in terms of hundredweights per minute, which every size and shape of ingot mould has to be filled. Additional to this, variations exist for the composition of the steel, not only as regards the carbon content, but also in relation to the quantity of special elements added. These tables are most carefully guarded, as not only has the cost of their preparation been enormous, but their metallurgical value is of similar proportions.

On the other hand, in the iron foundry, teeming speeds vary with the foreman in charge and the state of his temper, and are referred to in terms of "slow," "quick," and "medium." Closely related to the teeming speed is the rate of cooling, as the latter varies inversely with the former. It has been definitely established that the mechanical properties vary with the rate of cooling. Thus theorists, as well as practical men, are agreed that teeming speeds are of prime importance. The question arises, "Can teeming speeds be controlled in the iron foundry?" Obviously, it would be useless to carry out experiments on these lines until the teemer can rely on receiving the iron at approximately the same temperature day by day. The corollary naturally is, "Can the cupola be so conducted as to give similar brands of iron at invariably the same approximate temperature?" Reserving for a moment the consideration of the latter question, but assuming the possibility of its accomplishment, the former, whilst undoubtedly difficult, should be possible of realisation for the larger castings. It would be necessary to teem mechanically, as this would allow of a large range of diameters of streams, a suitable ladle nozzle being chosen for the work in hand. Though a bottom-pouring ladle would be an innovation in most iron foundries, it would be found to be efficacious for those suitably designed, that is, with the provision of an overhead crane spanning the casting floor. The experiments would be commenced by having a series of the same or similar castings in a row, and varying and recording the time taken in filling each one. Though the collection of data would take time, its utility would soon show itself. Contrary to the usual belief, there is little difficulty in bottom-pouring cast iron, and as for the speed of adjusting the nozzle with reference to the runner, this can be accomplished remarkably quickly by experienced crane drivers and teemers. The practicability of teeming many castings from a bottom-pouring ladle can be demonstrated by comparison with a steel foundry, where, after warming up the stopper and nozzle with a medium-sized casting, a hundred colliery tub wheels will be teemed expeditiously, easily, and without waste of metal. Reverting to the question of the daily production of varying brands of iron at approximately the same temperature, this should be capable of accomplishment by the careful control of the raw materials. It is certainly expensive to have every consignment of scrap, pig-iron and flux analysed and carefully weighed before use, but the Cast-Iron Research Association, or any other body charged with the investigation of wasters or improvement of product, must know exactly the metallurgical conditions prevailing. The careful recording of weights and times is capable of producing some of the basic figures necessary for the economic industrial conduct of many of the more backward foundries, and it is to the possibly unrecorded knowledge of these two factors which maintain their reputation amongst their customers.

### Board of Trade Announcement.

The attention of British subjects resident in this country who have pre-war debts owing to them from branches outside Germany of German undertakings whose head office is in Germany, is drawn to the fact that, apart from their remedy against the branch, they may be entitled to claim payment alternatively from the head office through the Enemy Debts Clearing Office. In the event of there being any doubt as to recovery of such debts from the branch, British creditors will be well advised to file a claim against the head office with the Enemy Debts Clearing Office, Cornwall House, London, S.E.1 It is essential, however, that any such claims should be received by the Clearing Office before September 30.

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AT the recent meeting of the council of the Engineering Institute of Canada, in Montreal, it was decided that the next annual meeting of the Institute should be held at Winnipeg in February, 1922.



XUM

# The Manufacture of Steel Castings in Green Sand.*

By W. H. Roesner.

Developments during the past year have forced many of the casting plants originally equipped for handling a specific or standard line of work, to take on practically any kind of work that could be secured to keep furnaces working as nearly to capacity as possible and to hold a working organisation together. In fact, in many cases the foundry manager was confronted with the alternative of making castings usually considered entirely outside of his province or of closing his plant.

Usually many of these castings are made in dry sand moulds and where a foundry is provided with the necessary facilities for drying the moulds, the practice probably will be continued indefinitely. The instances cited here merely are presented as evidence that comparatively difficult castings can be made satisfactorily in green sand, provided proper precautions are observed.

The quality of the sand is the most important feature to be considered when making steel castings in green sand moulds. It should have a high silica content and be open and free venting. Additionally, the vent wire should be applied freely all over the surface of the pattern, but especially in pockets or other confined spaces. The amount of clay used in the facing sand mixture should be held to a minimum. The clay should be kept dry and stored in well-covered bins. A great deal of trouble is experienced in many foundries due to the fact that the clay is wet when it is added to the sand in the grinding pan. Some of the clay remains in lumps and some of it sticks to the bottom of the pan. Facing sand of this character,

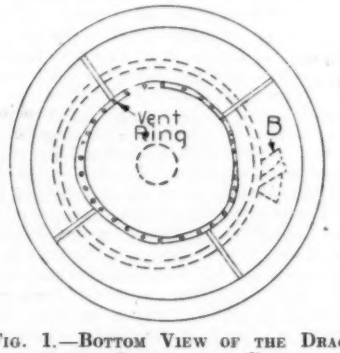


FIG. 1.—BOTTOM VIEW OF THE DRAG BEFORE SETTING THE CORE.

unevenly mixed and with lumps of clay scattered through it will cause dirty and scabby castings.

Occasionally it is desirable to add silica flour to the mixture, particularly in cores that are surrounded with metal or in the facing for heavy castings. Core binders also, both liquid and solid, are necessary in some cases, and where a binder of this character is employed the amount of clay in the mixture may be cut down proportionately. With some sand mixtures, plain water may be employed to bring them to the proper temper, in others it may be advisable to use molasses water.

The relative proportion of old and new sand will depend on the character of the work and this is a point in which the judgment and past experience of the foreman or superintendent will serve as a guide. As a general rule, it may be stated that practically all old sand may be used on castings of extremely light section and the proportion of new sand to old will increase according to the thickness of metal section in the casting.

The castings that may be cast successfully in green sand moulds range from ¾ to 1,200 pounds, many of them are machined all over, such as a pipe forming part of a high pressure steam line. A brake drum, ordinarily, would be regarded as a difficult steel casting to make in green sand. It is machined all over and must be free from flaws and pin holes.

* Extracted from the "Foundry."

This pattern was mounted on a jar-ram, roll-over, pattern-draw machine, which made the complete mould in the drag. The cope side was a cover core and the metal entered the mould through a tangential opening in a core rammed against the face of the pattern near the bottom edge. The gate core was made the shape indicated in the illustration *B* Fig. 1 to prevent it from working loose under the influence of the stream of steel. After the drag was rammed and set on the floor, the gate core was dropped into place. The centre core also was set and then the cover core was set on and fastened in place as shown in Fig. 2. At first this was done by clamping a narrow iron strip across the top, but later it was found that weights are more convenient.

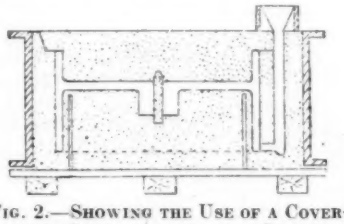

FIG. 2.—SHOWING THE USE OF A COVERING CORE IN PLACE OF A COPE.

All small moulds are poured with hand ladles shanked from a 3-ton ladle. These particular castings were comparatively light and of even cross section throughout and, therefore, it was not necessary to provide large risers or sink heads. Two small *pop-offs* were sufficient.

A large internal brake drum upon the rim of which teeth are cut later for a sprocket chain was partly machined as a check on the quality of the metal and also to see if the dimensions had varied since the first one was made. This casting also was made by the cover-core methods for machine production. The runner was in the centre of the cover core and was connected at the bottom to the drum by three S-gates. Three heads of ample proportion were arranged at equal distances on the flange to compensate for the shrinkage.

The drag pattern was fastened on a well-made follow board and the moulds were rammed on a jar-ram roll-over machine. After receiving the necessary number of jolts, the drag was butted off with a pneumatic rammer, struck off flush with a straight edge and then the surface was vented thoroughly. The bottom board then was rubbed on, clamped, and the drag rolled over. After the pattern had been removed and the mould finished where necessary it was skin dried by an oil torch. A plain 6 in. cope, rammed in a flat board, was

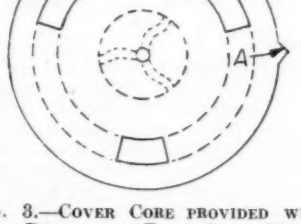


FIG. 3.—COVER CORE PROVIDED WITH ONE RUNNER AND THREE RISER HOLES. THE V-SHAPE PROJECTION IS A GUIDE FOR SETTING THE CORE.

employed to cover the covering core. A gate pin and three riser blocks were rammed up in this cope to correspond to the holes in the covering core. The covering core was guided into its proper relative position by a V-guide shown at *A* Fig. 3.

All moulds for steel castings, made in green sand, should be poured soon after they have been closed. It has been the writer's experience, es-

pecially in skin-dried moulds, that moisture gathers on the face of the mould or the cores if they are allowed to stand for any length of time. Pin holes in steel castings largely are due to this cause. Pin holes also can be due to metal that has not been properly deoxidised, but the character and appearance of the holes is different and readily will be apparent to any person after a little observation.

An internal brake band which is used with the brake drum just described is mounted on a jar-ram, roll-over, pattern-draw machine. The gate is cut with a branch on either side of the square core and a lump-head riser is provided on the opposite side. Before the flask is poured, it is tilted up a few inches at the riser end. As the mould fills with metal the gases gradually are driven out and a good casting results.

An 8-in. high pressure equaliser pipe which weighs about 1,200 pounds, has two test bars cast on, one for the customer and one for the shop. The mould is made in the usual jobbing foundry manner, with ample provision for risers. The core in a casting of this kind must be made in such a way that it will offer minimum resistance to the contraction of the casting. The heads also must be relieved immediately after the casting has been poured, to prevent checks or cracks developing around the flanges or at the turns. Locomotive cross-heads are usually made in a dry sand mould, but these also were made in a highly satisfactory manner in green sand. The cleaned castings weigh 530 pounds

A special flask was provided for making this casting. It contained two holes at the joint of one end, one for the riser and the other for the runner. The pattern was split through the centre and the mould was made on the floor in a horizontal position. After it was rammed and thoroughly vented, it was taken apart, finished, and skin dried, and then it was assembled and lowered on end into a pit. The mould was poured from 2 cwt. ladles suspended from two electric hoists.

Coupons and test bars were cast with these castings which had to conform to the most rigid chemical and physical specifications. The castings are machined all over and must be free from shrinkage checks, pin holes or other defects. The serial number, the words *electric steel* and an identification mark corresponding to the heat number are cast on the inside of each casting.

Making these castings in green sand calls for proper materials, judgment in placing heads and gates and care in moulding. It is a mistaken idea that sand cannot be rammed too hard for steel castings. That method might obtain in the case of dry sand moulds, but for green sand moulds the sand only should be hard enough to resist the strain of the liquid metal. A final admonition is that after the mould has been rammed and vented it should be vented again.

## The Calculation of the Weights of Castings from the Weights of their Patterns.

The following table gives the factors to be used for the calculation of the weights of castings from the weight of the pattern, and is taken from "Modelage Mecanique" by Maurice Champdecler.

| Material of Pattern. | Cast-Iron. | Bronze or Copper. | Aluminium. |
|---|---|---|---|
| Mahogany .. .. | 11.75 | 13.6 | 4.4 |
| Alder .. .. .. | 15.0 | 17.0 | 5.0 |
| Birch .. .. .. | 10.0 | 12.25 | 3.35 |
| Oak .. .. .. | 9.0 | 10.35 | 3.0 |
| White metal .. .. | 0.9 | 1.05 | 0.38 |
| Cast iron .. .. | 0.96 | 1.15 | 0.35 |
| Beech .. .. .. | 10.0 | 12.30 | 3.35 |
| Brass .. .. .. | 0.85 | 0.98 | 0.25 |
| Walnut .. .. .. | 11.0 | 12.5 | 0.21 |
| Lead .. .. .. | .65 | 0.75 | 3.45 |
| Pear .. .. .. | 10.5 | 12.0 | 3.45 |
| Pine .. .. .. | 14.5 | 16.0 | 4.75 |
| Linden .. .. .. | 13.4 | 16.0 | 4.0 |
| Zinc .. .. .. | 1.0 | 1.6 | 0.4 |

## Armoured Concrete Road Construction.

Mr. W. F. Bradley, writing in a recent issue of *Motor Transport*, states new and somewhat original type of road construction has been devised by the Pont-à-Mousson Steel Works in France, and has been experimented during the last six months on one of the streets of Lyons carrying exceptionally heavy traffic.

The essential feature of this road is the use of cast iron in conjunction with concrete, forming what may be described as an armoured concrete road. A concrete foundation about 4 in. in thickness is covered with a surface dressing of Portland cement, and while this is still soft it receives the cast-iron members shaped as shown in the accompanying illustration, and having a height of 1¾ in. The elements weigh about 1¾ lb. each, and are laid from sixteen to twenty-five to the square yard, according to the intensity of the traffic. The metal surface is then covered with fine concrete, which is laid before the cement surface is quite dry, and is finally well stamped down and left to dry slowly.

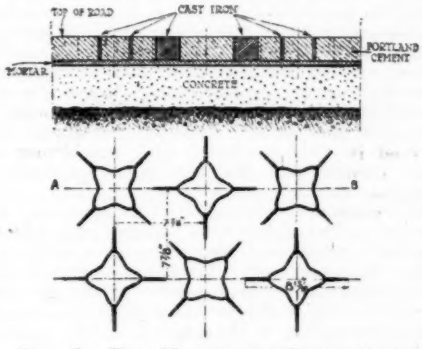


FIG. 1.—THE METHOD OF CONSTRUCTION ADOPTED FOR CAST-IRON AND CONCRETE ROADS.

The street in Lyons selected for experimental purposes is one carrying very heavy traffic, for it is opposite the main goods station, and as there are no tram lines it is preferred to other arteries by drivers of heavy lorries. A report has been issued by the municipal road engineer after six months' service, and is on the whole very favourable towards the new system. It stated that the cast-iron elements, which were covered when the road was quite new, are now visible, and that they project very slightly, but do not offer any inconvenience to traffic. For all practical purposes the surface may be considered as perfectly smooth; it gives off less dust than the surrounding granite-paved streets, and it allows water to run away readily.

The cost of construction of this road is stated by the municipal engineer to have been 26 frs. 70 per square metre, but this price is higher than normal, owing to the fact that the men had had no previous experience in this type of road paving. After the first portion of the road had been laid, the cost was reduced to 25 frs. per square metre, and it could be brought down even lower. As a matter of comparison, the Pont-à-Mousson Steel Works give the pre-war cost as 19 frs. per square metre, compared with 22 frs. 6 for asphalt, 22 frs. 65 for wood, 23 frs. 86 for granite on sand, and 26 frs. 60 for granite on concrete.

**DUCTILE MANGANESE BRONZE.** — For good quality manganese bronze, La Fonderie Moderne recommends the following alloy:—Copper 57, zinc 40, tin 0.5, iron 1.0, manganese 0.75, aluminium 0.75 per cent. After melting the copper, the iron is added as tin-plate, and manganese as cupro-manganese (30 per cent. manganese). If 2½ lbs. of cupro-manganese are added, this will introduce 1¾ lbs. of copper, which must be deducted from the copper originally charged, leaving for this 55.25 lbs. on a 100-lb. charge. The aluminium is added before the zinc. When everything is melted the mixture must be thoroughly stirred and teemed into ingots, and if castings are required, the ingots should be re-melted.

XUM

## Automatic Heat-treating Furnaces.*

By Gilbert L. Lacher.

Automatic electric furnaces for the heat treatment of automobile forgings, recently installed by C. H. Wills & Company, Marysville, Michigan, are said to represent the latest development in equipment for the heat treating of automobile forgings.

With exact control of time and temperature guesswork is eliminated from heat treating, and the physical properties of steel can be developed to the maximum. When the desired treatment has been determined, the equipment is set for the proper time and temperature for the furnace, and there is also a similar automatic regulation of the quenching operation. Then, without the need of a skilled operator, the furnace will repeat any heat treatment on a tonnage basis as long as desired.

Built by the Electric Furnace Company, Alliance, Ohio, this heat-treating equipment consists of a set of two similar electric furnaces, each with a hearth substantially 5 ft. wide and 15 ft. long, having an electrical capacity of 400 kw. for the combined unit, and a heat-treating capacity of 1,500 lbs. per hour. As the material to be treated consists of a large number of parts of different size, ranging from axles and crank shafts down to the smallest parts entering into the construction of the car, it was necessary, to get the most convenient operation, to place all the material in pans or containers. The parts remain in these pans through the hardening and quenching operations, and through the tempering operation as well.

Electric motors, actuated by a time-clock mechanism, raise and lower the furnace doors, advance the material through furnaces and quench, and make it unnecessary to have any conveying mechanism within the hot zone of the furnaces. The entire equipment is "fool proof." The only manual operation is the placing of the material on the charging platform.

A loaded container is placed on the charging platform before the pusher of the hardening

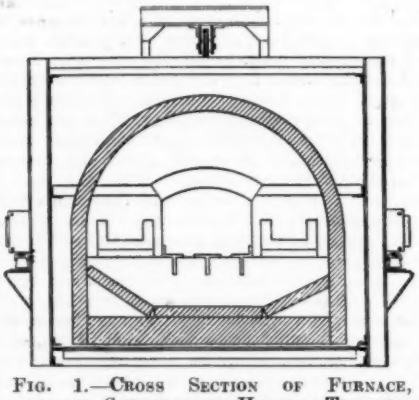

Fig. 1.—Cross Section of Furnace, showing Carborundum Heating Troughs.

furnace; the equipment is set for a given treatment, and when the pan nearest the discharge end of the furnace has received this treatment the doors automatically open, the cold pan is then pushed into the furnace, and all the pans within are moved along so that the last pan is discharged into the quench. The hearth is inclined 15 deg. to minimise this push, and prevent the crushing of the furnace pans.

The automatic quenching equipment has a counter-weighted carriage which butts against the discharging door of the hardening furnace. When this door is raised the carriage slides in and receives the outcoming loaded pan. This added load overcomes the effect of the counterweight, and the carriage slides down into the quenching tank. Here the loaded pan is caught on a conveyor, and the carriage, relieved of its burden, rises and again butts against the furnace door until another pan of material is ready to be discharged. The first pan remains in the quenching tank for the fixed length of time, and then the conveyor mechanism carries it up on to the drain board, or, if desired, bears it direct to the charging platform of the tempering furnace. The tempering furnace operates in exactly the same manner, except that the material is discharged to the air. Unless the equipment is set for a different treatment, the same process will be exactly repeated every day.

The heating principle of these furnaces is very simple. Carborundum troughs are placed lengthwise on either side of the furnace hearth. These troughs are connected outside the furnace to special oil switches, and these switches are, in turn, connected to the transformer taps corresponding to the power input and temperature desired. Closing a switch passes a low voltage current through the carbon in the trough, and quickly brings this carbon to incandescence. The heat thus generated is radiated from the bottom of the trough underneath the elevated hearth, from its sides direct to the hearth, and from the top of the trough to the roof and thence reflected to the hearth. This results in a large source of relatively low temperature heat, uniformly distributed throughout the furnace.

* Extracted from June 30 issue of "The Iron Age."

## The Standardisation of Copper.

According to Mr. Lorenz, of Duisburg, copper can be classified in three qualities—hard, medium, and soft—which have the characteristics shown in Table I.

*Table I., Showing the Characteristics of Copper.*

| Quality. | Minimum content of | | | Use. | Max. stress tons, sq. in. | Elongation per cent. |
|---|---|---|---|---|---|---|
| | Cu. | As. | Ni. | | | |
| Soft .. | 99.4 | — | — | Sheets | 13.3 | 35 |
| | | | | Bars | | |
| | | | | Wire | | |
| Medium .. | 99.0 | 0.25 | 0.10 | Sheets | 14.0 | 38 |
| | | | | Plates | | |
| | | | | Bars | 14.6 | 38 |
| Hard .. | 98-75 | 0.50 | 0.15 | Plates | 14.6 | 38 |
| | | | | Bars | 15.2 | 38 |

In samples of copper foreign matter may exceed 0.5 per cent., and bring in quite remarkable mechanical properties. The harmful impurities are antimony, bismuth, and sulphur, whilst arsenic and nickel do not exercise any deleterious influence.

According to the American Society for Testing Materials, the normal conditions should be as follows:—(a) Chemical composition, 99.88 per cent. of copper; (b) conductivity—for wire (annealed) 98.5 per cent., for annealed pig-copper 97.5 per cent. Sheets, bars, etc., come into the same category of pigs, so long as they are not for electrical purposes.

For annealed copper wire 0.15302 of an international ohm at 20 degs. C. is taken as a unit of resistance for a metregramme.

According to the "Berlin Bourse Calendar" for 1914 the following varieties of copper could be accepted:—(1) Without any guarantee as to composition or category; (2) with a single analyst's certificate as to composition and category; (3) as in No. 2, but with certificates from two chemists. In this calendar the specifications for old copper coming from various sources are detailed.

The International Association for Testing Materials specifies the following for sheets and plates:—

*Tensile Strength.*—14 tons per sq. in., elongation 35 per cent. A 12 cwt. lower test is allowed for the tensile strength, and a 2 per cent. greater elongation is tolerated.

The current expressions employed for copper are as follows:—(1) Black copper, a metallic product containing 90 per cent. of copper, the principal impurity being sulphur; it has no commercial use, having to undergo further refining. (2) Annode copper, a material containing 97 to 99 per cent. of copper in the form of anodes, used for further electrical refining. (3) Old copper, including every type of scrap. (4) Refined copper designates all copper which has been refined in the reverbatory furnace and is of such purity that it can be used for rolling or for alloying. (5) Electrolytic copper; this is the metal obtained at the cathode by the electrolysis of an aqueous solution of a copper salt. It is subdivided into the original cathode metal and this material remelted.

# Foundry Reorganisation.—Part I.

By H. W. J.

That "unprecedented demand" for castings, consequent upon the moulders' strike and the trade boom, having been satisfied, the foundries of the world are, in common with every other section of industry, experiencing a very lean time. The change was sudden and sharp, and, to the bulk of foundrymen, quite unexpected. When, early last year, the slump in the motor industry was experienced, certain foundries were perforce affected, but so insistent was the demand for castings for the other sections of the engineering industry that it was only a question of changing over, and the order-book was full again.

Now, however, the supply has overtaken the demand, and the foundries search in vain for even remnants of past orders. Prices are reduced, deliveries are guaranteed, but even these inducements fail to interest the buyer, the reason being that he cannot create a demand for *his* commodity.

But why is it? On this showing his material costs are reduced, and not only castings, but steel and all other raw materials. His own workers, too, have accepted substantial reductions in wages, so that one would think he could reduce the selling price of his commodity and so create a demand.

The trouble, however, lies deeper than this, for it is to be feared that the foundry is hit far harder than other sections of the engineering industry, and that if the British foundry is to regain its erstwhile supremacy a drastic reorganisation is necessary.

During the moulders' strike, and during the boom which succeeded it, a great many British orders for castings went abroad—notably to Belgium, and the British manufacturer, being satisfied both with the quality and the price, is in no hurry to make a change. He really has no inducement to do so, seeing that the Belgian casting is in most cases equal in quality to the British product, whilst the cost is considerably less.

The rate of exchange undoubtedly has a tremendous influence on the question of price, but the Belgian founders express confidence that, even when the exchange approaches the normal, they will still be able to quote a competitive figure. And why? Not because their men are working 12 or 14 hours a day, for a working day consists of but 8 hours, but because the foundry organisation is superior to ours. Belgium is setting out to become the premier castings country, and unless we, too, are on our mettle, she will succeed.

When we can sell all that we can produce, there is no incentive to devise new methods, but when the lean times come, then it is that we must look about and endeavour to create a demand. We have reduced our prices, and promised better service, but it is not enough. We have got to reduce our overhead charges, as the Belgians have done.

It is the overhead charges which are killing the British foundry, and, candidly, they cannot be defended. What is the use of reducing the margin of profit in order to get business if 400 or 500 per cent. is being added to the labour costs by way of establishment charges?

The only way to reduce these is by a drastic reorganisation, not necessarily of pulling down the foundry and rebuilding (though this would, in many instances, be a real money saver), but by getting the last farthing from the existing building. There is not a foundry which could not produce cheaper if the right methods are employed, and it is up to the foundry proprietors to put their backs into it and to make up their minds to have a foundry worth owning, one which can hold its own amongst all comers.

We are not alone in this great slump, for the States are worse than we are, whilst the same may be said of most of the Continental countries. The foundries of Belgium are on short time—the writer visited two large Belgian foundries at four o'clock in the afternoon and found them closed—but they are working almost entirely on foreign orders—mostly British.

The Dutch foundries are in the same melancholy state, and the French are very little better. So far as Germany is concerned, the foundries are fairly busy—again on foreign orders, but everywhere the slump is apparent. This being so, there is no reason for us to despair if only we set to work with a will.

It is suggested that the Belgians are fighting against on-cost, and this is apparent when the principal actively interests himself in the business, when he travels and personally interviews present and prospective clients. He is for ever on the move, and gets but little rest, but he neglects no opportunity, and no business is lost through any shortcoming on his part.

His managers, too, are alive, and evince a lively interest in the business. It may be that our managers are alive, but in the writer's opinion their business training has not been allowed to develop. Most of them are good foundrymen, capable of achieving much if thoroughly exploited. It seems certain, however, that real business aptitude is not so pronounced as it should be.

The average foundry manager is a foundryman pure and simple, and is not a general engineer. It may be argued that there is no reason why he should be, but although it is not suggested that he should be as proficient in other branches of the engineering industry as he is in foundry work, it is desirable that he should have more than a nodding acquaintance with work outside his own particular sphere, if only to appreciate the views of his customers.

It is necessary, too, for his own sake, for it develops a broader view and makes it possible for him to grasp possibilities and probabilities in such a way as to put them to good account. After all, foundry work is but the beginning, and is not often complete in itself. The commodity may be substantially a casting, but the moulders' work in connection with it is proportionately small compared with the subsequent operations in the machining departments and elsewhere which are necessary to transform the piece into a saleable commodity.

But whilst the foundryman must not take an exaggerated view of his own importance, it is equally a mistake for him to belittle it. He *is* an important man, and it is well that he should know it, for he provides the foundation of the commodity, and to a very great extent determines whether it will be good or bad. If he realises this, and sets out to produce a good casting, at a competitive figure, then he is on the right track.

He must not, however, allow his artistic proclivities to predominate, and that is why he must pay attention to the commercial side of his calling. Too many men fail to consider this. They are craftsmen, and take a delight in their handiwork, but though this is a thing of beauty, it is not a paying proposition. They do not think of such sordid matters as pounds, shillings and pence, but the casting is made to sell, and not to remain in the foundry showroom.

It is not always recognised that the customer, though obviously not wanting "waster" castings, does not intend to pay a fancy price for a casting of superfine quality. He wants a utility casting consistent with the duty which it has to perform. The foundryman may argue (and quite rightly) that his product is the best, but as a matter of fact it is, in all probability, too good.

A foundry manager is no doubt a cleverer man than a coremaker, but it does not follow that he could beat the latter at his work, and even if he could, it is certain that the foundry proprietor would not pay manager's wages for coremaking. And so it is with the product. The customer will not pay 50s. for a casting when he can get one which will answer his purpose for 25s.

It will be a big step in the right direction when our foundries set out to produce the casting for the job, for a substantial reduction in the manufacturing costs will automatically follow. And having got thus far, incidental costs will also fall, for the reorganisation necessary to ensure the former will undoubtedly take care of the latter. The adoption of labour-saving machines, the eliminating of all superfluous handling, both in the foundry and in the trimming shop, a rigid system of inspection, and a definite record of "wasters"

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shown against the individual, all follow as a sequence, and non-productive costs come down with a bump.

The time now is opportune for drastic reorganisation, for the old methods will not do. Other countries are not so far in front as to suggest that we cannot regain supremacy, but we must start now. A reduction in price, based simply upon lower wages, is not going to help, for it will not bring in the necessary orders. Other countries can beat us in this direction, but if we introduce new manufacturing methods, and make a determined onslaught upon those "establishment charges," which in the main cover waste and inefficiency, then we can look to a new era of prosperity.

Prices for British castings are now down 50 per cent., compared with those ruling 18 months ago, and although this appears to be a substantial reduction, it is not so much when it is remembered that the prices ruling 18 months ago were 200 per cent. above those quoted two years before that. It may be said that we shall never get back to the prices of four years ago, because they did not pay, but this argument will not hold water, for if, with the advantage of modern ideas and the help of new appliances, we cannot beat our achievements of that period, then we do not deserve to win, and the sooner we are out of the business, the better.

Belgian castings can now be bought for less than 2d. per lb., and this in a foreign country. It may be argued that the foundries are working at a loss, but this is not so, as their books will prove. These foundrymen have no money to play with, and they realise it. So they set out to prevent waste, and to ensure that all the money they spend brings in a return. They make no secret of their intent to become masters of the situation, and at the present time even the Germans cannot compete against them.

Yet, despite this, they have not enough orders to keep their foundries fully employed. The present output looks a lot, and would satisfy many a British foundryman with a foundry of similar size, but it is not enough for the Belgian. *His* foundry is capable of producing much more, and because he cannot get the orders he works short time.

So whilst this shortage of orders exists we must reorganise, and increase the capacity of our foundries. We, too, are working short time, but there is no reason why we should. It must be remembered that the Belgians are working on British orders, and that at the present time they have practically no home market. *We* have, if we care to capture it, and it is up to us to do so. Trade will undoubtedly revive, and before long, and no doubt our foundries will again be fully employed. But unless we now take the necessary steps our production will still be limited, and we shall have the melancholy satisfaction of seeing huge orders going to the Continent—orders which, with reasonable precautions, we could divert to our own foundries.

**LARGE CONTRACTS TO BE PLACED IN AMERICA.**—Plans for the vehicular tunnel which is to be constructed under the Hudson river, between Manhattan island and Jersey City, are nearing completion. It is preliminarily estimated that 115,000 tons of segment castings will be required. These castings are to be of grey iron and their construction is to be practically the same as those used in the construction of existing tunnels in New York harbour. In addition to the segments, other castings will be required in connection with the drainage, ventilating and lighting systems. Principal materials required include 4,000 tons of 1¾-in. bolts, including washers and nuts. The bolts possibly may be of nickel steel. Constructional steel to the extent of 12,000 tons and approximately 3,000 tons of reinforcing steel will be required for use in the approaches, etc. Estimates place the number of barrels of cement at 250,000, while 1,000 to 2,000 tons of cast-iron, wrought-iron and steel pipe will be required. In addition, electric wire and appliances will be needed. Owing to a controversy between the New York and New Jersey commissions, progress in building the tunnel has been delayed, but this now has been tentatively settled and bids are expected to be asked for shortly.

## Strickles.

By J. GERRARD.

For the moulding of such castings as condensers, a spindle at least 16 ft. long is necessary. This must fit into a socket at the base and be held firmly in position at the top by an arm fastened to the wall or column, and fixed in such a manner as will ensure the spindle being perpendicular and rigid.

In the choice of an arm preference should be given to the type which incorporates a loose cap, fitting into a slide and fastening itself into position. The arms used or the spindle itself, to which the board is attached, are by no means standardised. Almost every foundry has developed having its own type, some being made incorporating loose caps, which are fastened to the body of the arm and work in and out of position by means of a hinge joint. Others are made all in one piece, only provided with a hole and machined to the exact size of the spindle.

It often happens that both a right and left-hand board are necessary for the one job, and the second board cannot be placed in position without lifting the spindle out of place and turning over the arm to suit the board.

It is in such cases that a lack of foresight on the part of the pattern-maker is exhibited, and such details often mean a waste of time and money, due to the necessity of moulders waiting for the crane to lift out the spindle. A useful type of arm is one that can be easily adjusted and is suitable for use with boards of either hand, and which eliminates the use of the crane for moving the spindle.

It is an impossibility to set a board correctly unless the cutting edge comes directly opposite the centre of the spindle. This is mentioned because moulders occasionally use boards fastened to the arm with the cutting edge away from the centre.

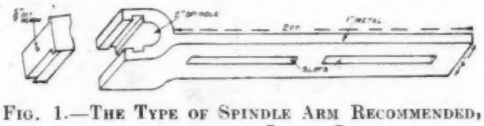

FIG. 1.—THE TYPE OF SPINDLE ARM RECOMMENDED, TOGETHER WITH LOOSE CAP.

In the construction of the loose cap care should be taken that it be made with sufficient clearance to allow of easy fitting.

This cap is provided with a ⅝ in. set-screw, terminating with an eye, and so eliminating the necessity for the use of spanners.

The set-screw touching the spindle forces the cap back against the shoulder in the arm, as shown in Fig. 1, and consequently brings the arm to an exactly horizontal position.

The arms can be made of various lengths as occasion requires. Where any great amount of spindle work is carried out this type of arm effects a great saving both in time and money.

When a long board is in use in conjunction with more than one arm it is a simple matter to fix the board in position temporarily by fastening it to the arms when laid on the floor. It is then easy to raise it and place round the spindle. This method is practically impossible with the type of arm commonly in use.

The usual simple method of fastening the board to the arms is by the use of loose bolts passed through the board and also through the slots in the arm as shown in Fig. 1. This method could very easily be improved upon and a great deal of time and trouble saved in consequence.

For instance, strips of wrought-iron plate, about 10 in. x 2 in. x ½ in., could be used by tapping a couple of ⅝ in. set-screw holes in these at about 8 in. centres and making these centres a standard. This saves the pattern-maker the trouble of drilling a number of unnecessary holes through the board. This method should be adopted as in the case with the fastening of the arm, that is, the using of eye-bolt set-screws, which again does away with the necessity for spanners. Obviously there is thus no need for any tools whatever in the fixing of either the arms or board. It often happens that as many as four different sizes of bolts are used for this purpose, with a corresponding waste of time in adjusting.

# Cast-Iron for Automobile Engine Castings.

Commercial cast-iron is the highly carbonised iron product of the smelting of iron ore in the modern blast furnace, and contains, in addition to carbon, quantities of other constituents which vary according to the composition of the blast-furnace burden and the method of working employed. These other constituents are chiefly silicon, manganese, sulphur and phosphorus. Very small amounts of other elements are frequently found in commercial cast iron, depending largely on the composition and origin of the ore smelted. They consist principally of copper, aluminium, arsenic, titanium, together with smaller amounts of still rarer elements. Even in the solid state commercial cast-iron contains quantities of dissolved or occluded gases, principally carbon monoxide and hydrogen. Troost and Hautefeuille have shown that the gases in cast-iron are chiefly carbon monoxide and hydrogen, roughly in the relative proportions of seven of the former to one of the latter. Professors Carpenter and Ruggan have confined these results, and have shown under certain circumstances that carbon dioxide is also present.

### Constitution of Cast Iron.

It is customary[1] in considering the constitution of this exceedingly complex alloy, cast-iron, to conceive of it primarily as a simple binary alloy of iron and carbon containing varying quantities of the additional elements above-mentioned, and investigation is therefore directed with the object of ascertaining the influence of these additional elements in modifying the properties of the basal iron-carbon alloy. This procedure has been justified by the results of researches on the physical and mechanical properties of cast-iron, which have shown that the influence exerted by the additional elements on the majority of these properties is exerted through their influence in the modification of the condition of the carbon in the alloy.

The most important constitutional property of the pure-iron-carbon alloys, containing total carbon in excess of 2 per cent. (to which branch of the series cast-irons belong) is the possibility of the carbon existing in two distinctly different conditions, which in their turn vitally modify the physical and mechanical properties of the alloys.

In the first case it is found that the alloy may be nearly glass hard, unmachinable, brittle, having a high degree of total shrinkage on solidification from the molten state. A freshly-broken fracture of the alloy shows a white, hard, crystalline appearance. In this condition the carbon exists in the alloy as the chemical compound—carbide of iron. This compound exists in the solid alloy partially free and partially dissolved in iron as a solid solution of carbide of iron in iron. The relative amounts of free and dissolved carbide present depend upon the chemical composition and thermal treatment of the alloy.

In the second case it is found that if this white, hard alloy is slowly cooled from the molten state at a sufficiently slow rate the alloy becomes soft, machinable and less brittle. An examination of a freshly-broken fracture in this case shows a grey appearance, in which the presence of free graphite in a plate-like form is visible to the naked eye.

It is considered that by extremely slow cooling the carbide undergoes decomposition into its constituents—iron and free carbon. The actual extent of the decomposition, other things being equal depends on the actual rate of cooling.

For the direct production of castings of commercial value alloys of this second type only are satisfactory. Alloys of the first type are unmachinable, and are only of special value as direct castings. The prolonged annealing of white-iron castings of suitable composition results in the production of a soft machinable material in which form it is known as malleable cast-iron.

*Influence of Silicon.*—Next to carbon, silicon is the most important of the elements present in commercial cast-iron. Its most important influence is its marked effect in increasing the extent of the decomposition of the carbide with the consequent production of graphite. The exact mechanism of the influence of silicon in promoting the decomposition of the carbide is still undetermined. The silicon probably exists as a chemical compound, silicide of iron, which is perfectly soluble in the iron and which, consequently, cannot be separately identified under the microscope.

With the rates of cooling, normally encountered in the iron-foundry, commercial cast-irons containing from 0.75 per cent. to 1.00 per cent. silicon have a white or partially white fracture and are practically unmachinable. With silicon in excess of these values increasing proportions of graphite begin to appear in the alloy according to the actual percentage of silicon present and the rate of cooling to which the alloy has been subjected.

In addition to promoting the formation of free carbon the presence of silicon also results in a reduction of the total carbon present in the alloy over that of the corresponding pure iron-carbon alloy.

*Manganese.*—The influence of manganese on the iron-carbon alloys is intimately bound up with that of sulphur. In the absence of sulphur the manganese exists as a carbide of manganese very similar to the carbide of iron. It is usually considered that manganese tends to increase the stability of the carbide, and on this account to retard the formation of graphite. In the presence of silicon, however, it has been shown* that small quantities of manganese actually increase the extent of the formation of the graphite.

*Sulphur.*—Probably the most important influence of manganese from a commercial foundry point of view is its influence in combining with the sulphur, forming a compound of manganese and sulphur. This compound is insoluble in commercial cast-iron and can readily be identified under the microscope in the solid alloys containing

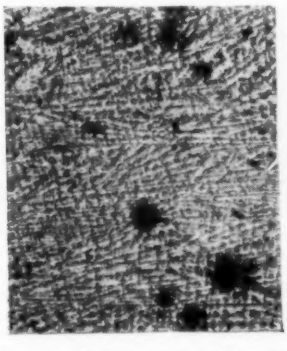

FIG. 1.—SECTION FROM CHILLED EDGE OF CASTING. ETCHED $HNO_3 \times 75$ DIAS.

FIG. 2.—SHOWING FERRITE AND GRAPHITE. ETCHED $HNO_3 \times 400$ DIAS.

FIG. 3.—SHOWING GRAPHITE, FERRITE AND SOME PHOSPHIDE. ETCHED $HNO_3 \times 100$ DIAS.

ALL HAVE BEEN REDUCED ON REPRODUCTION.

* Hague and Turner. J.I.S.I., 1910. Vol. II

manganese and sulphur as small isolated patches of dove-grey-coloured constituent (manganese sulphide). In this form the manganese and sulphur have little or no influence on the condition of the carbon.

In the absence of manganese the sulphur exists as the sulphide of iron, which is soluble in the molten cast-iron, and in this condition exerts a powerful influence in preventing the formation of graphite. So much so, that it has been stated that in cast-iron containing 1 per cent. of silicon the presence of 0.01 per cent. sulphur prevents the separation of 0.02 per cent. graphite. In alloys containing a higher silicon than this the influence of the sulphur is not so marked.

*Phosphorus.*—The influence of phosphorus in commercial cast iron is of considerable importance from many points of view. It exists in the alloy as the phosphide of iron ($Fe_3P$) which separates out of the alloy on solidification as a low melting-point eutectic. This phosphide eutectic has a melting point considerably below that of the iron-carbon alloy, its melting point being about 980 deg. C. On the solidification of commercial cast-iron containing phosphorus, this constituent is the last to solidify, and on this account the cast iron has a greater fluidity and longer "life" compared with a similar cast iron not containing phosphorus. It has been shown that phosphorus in the quantities usually met with in commercial cast iron has very little influence upon the condition of the carbon. If anything, it probably exerts a slight tendency towards increased production of graphite, a fact which may be ascribed to the lower freezing temperature of phosphoric irons.

The phosphide-eutectic constituent exists in the solid alloys as a separate constituent which is readily detected on account of its extreme hardness and the fact that it is unaffected by the usual etching re-agents. On this account it can often be observed in relief in the unetched specimens, and in etched specimens it exists as a white constituent having a typical eutectic structure. Phosphide-eutectic is almost as hard as the carbide of iron and is very brittle.

### Structure of Commercial Cast Irons.

The structure of commercial cast iron essentially depends upon its chemical composition and the thermal conditions, chiefly the rate of cooling to which it has been subjected. It will already be understood from what has been said that the extent of the decomposition of the carbide of iron, and hence the relative proportion of combined and free carbons will depend upon the ratio of the various constituents and the rate of cooling. The typical structure of a white iron containing traces only of free carbon or graphite is illustrated in Fig. 1. This photograph is taken from the chilled edge of a casting where the rate of cooling had been sufficiently quick to retain the carbide undecomposed. The white etching constituent is the carbide. The actual commencement of the formation of graphite from several centres is also indicated by the darker areas. A perfectly grey iron in which all the carbide has decomposed shows a microstructure consisting of plates of free graphite intersecting a ground mass of ferrite. Ferrite in cast irons consists of pure iron containing the silicon and also the manganese in solution. It is often distinguished from the pure ferrite found in mild steels by the title "silico-ferrite." A typical structure, showing a silico-ferrite matrix intersected by graphite plates, is shown in Fig. 2.

Intermediate between this and white iron, cast irons are obtained containing varying amounts of carbon undecomposed in the combined state. For the most part the undecomposed carbon in commercial cast irons exists as the micro-constituent, pearlite, which, excepting that it usually contains silicon, is identical with the pearlite found in steels, and is a dark etching constituent showing under high magnifications a typical lamellar structure. A typical micro-photograph of a commercial cast iron showing the graphite plates surrounded by the ferrite constituent in a matrix of pearlite, the dark etching constituent, is illustrated in Fig. 3. The phosphide eutectic is also illustrated in this same figure.

Commercial grey cast iron will, therefore, be seen to consist structurally of the micro-constituents ferrite and pearlite in varying proportions intermingled with grains of the hard phosphide eutectic. The whole of this structure is more or less cut up by the presence of the plates of free graphite. The importance of the microstructure in considering the physical and mechanical properties of cast iron will be at once apparent, and it will be appreciated that the amount, size and distribution of these various constituents, particularly the graphite plates and the hard and brittle phosphide eutectic, will vitally influence the mechanical properties.

### Mechanical Properties.

As would be expected, it is found that all those conditions which tend to influence in addition to the quantity, the size and distribution of the various constituents, influence to a marked extent the mechanical properties of the cast iron. These conditions, in addition to the chemical composition, are so far as is reliably known at present: (1) the rate of cooling; (2) the casting temperature.

In a cast iron of a given chemical composition it will be appreciated that the rate of cooling, in addition to modifying the relative proportions of combined and free carbon present in the alloy, also modifies in a marked degree the size and distribution of the constituents. The quicker the rate of cooling, the graphite and phosphide eutectic constituents are found to be in a more finely divided state, and the grain size of the cast iron is altogether smaller. The effect of this on the transverse strength of the iron is illustrated by the results given in Table I.

Table I.*—*The Influence of Rate of Cooling on the transverse strength of Cast Iron.*

| Bars. sq. in. | Cwts. per sq. in. | Deflection ins. | Remarks. |
|---|---|---|---|
| 1.00 | 24.07 | $\frac{1}{4}$ & $\frac{1}{32}$ | All bars 12 in. between centres. All results average of 3 determinations. |
| .75 | 26.33 | $\frac{3}{32}$ & $\frac{1}{16}$ | |
| .50 | 28.97 | $\frac{1}{16}$ | |
| .25 | 34.12 | $\frac{3}{8}$ & $\frac{1}{16}$ | |

The marked increase in the ultimate transverse breaking load in the bars of smaller cross-sectional area is to be entirely attributed to the quicker rate of cooling as a result of this smaller section. The whole of these bars were cast under, as far as possible, identical conditions from the same ladle of metal. The same effect is, of course, evident in the tensile test, and has been frequently shown.

The influence of the casting temperature on the strength of cast iron was first investigated systematically by Longmuir,† whose results show that a higher value in the tensile test is to be obtained when cast iron of the particular composition used by him is cast at a "fair" temperature as opposed to a "cold" or "hot." It is difficult to reconcile the subsequent investigations of Hatfield‡ and Hailstone§ from whose work, particularly the latter, it would appear that a higher tensile strength is obtained, other things being equal, in bars cast at a higher casting temperature. This latter view is probably the most nearly correct and, in any case, the casting temperature is not always governed by mechanical strength considerations. In such intricate work as automobile-cylinder castings it is necessary, in order to ensure the production of satisfactory castings, to run them with the hottest iron possible. In this connection it is of interest to note that Hailstone, in the investigation referred to above, found that bars cast at the higher temperatures were free from unsoundness and porosity, whilst those cast at lower temperatures were unsound.

All the investigators appear to be in agreement that the higher casting temperatures tend to increase slightly the percentage of combined carbon in the cast iron.

Before dismissing the subject of casting temperature the results obtained from cast iron prepared in the electric furnace and the so-called "synthetic cast irons" are of considerable import-

* Adamson, Manch. Assoc. of Engineers. Jan., 1910.
† Longmuir, J.I.S.I., 1903 and 1904.
‡ Hatfield, J.I.S.I., 1906.
§ Hailstone, J.I.S.I., 1916.

ance, and may not be altogether unconnected with this aspect of the subject. In a process* recently described for the production of synthetic cast iron by melting down steel borings in the electric furnace, the melted scrap is recarburised and suitable additions of silicon are added to produce a grey cast iron. In an actual case given a remarkably pure material of a high silicon content was produced, the composition of which was as follows:—Total carbon, 2.9 per cent.; silicon, 1.75 per cent.; manganese, 0.50 per cent.; sulphur, trace; phosphorus, 0.05 per cent.

It was stated that this material gave a tensile strength of 50 kilos per sq. mm., which is practically equal to 31.75 tons per sq. in. This value is far in excess of those ordinarily obtained from cupola cast metal.

*Tensile Strength.*—From what has been said it should be quite clear that the mere statement of the ultimate tensile strength of cast iron is of no value without some knowledge of both the chemical composition and the rate of cooling of the actual specimen—or in lieu of the rate of cooling, some knowledge of the dimensions of the cast specimen. In a like manner the tensile strength of cast iron is not solely dependent upon the chemical composition, and it cannot be said that any one chemical composition alone gives the highest result.

Of recent years, owing to increased care and supervision taken in the production of cast iron, very high values of tensile strength have been frequently recorded, and it is no uncommon occurrence for results of 20 tons per sq. in. and over to be obtained. Such results are for the most part obtained on test bars cast nearly to size (0.564 in. diam.), but results of 16, 17, and 18 tons per sq. in. can regularly be obtained on ¾ in. diam. sand-cast bars, cast direct from cupola melted metal.

In sand castings high-tensile strength is almost always associated with a finely-divided state of free carbon, together with the maximum quantity of pearlite in the microstructure. In general this type of structure is obtained (in sand castings) by adjusting the silicon content, in reference to the rate of cooling or the thickness of the casting, and the remainder of the composition, to the lowest possible value which will give a "perfectly grey iron" free from "structurally free from cementite," or, in other words, the lowest silicon content which will, in view of the thickness of the casting and the rest of the composition, give the maximum amount of pearlite constituent.

This does not take into consideration the value of the total carbon, and it is likewise true that the lower this value the higher the strength of the iron. It is, however, as far as cupola-melted metal is concerned, almost impossible to guarantee regularity in this constituent below a value closely corresponding to the eutectic percentage for the particular composition of the cast-iron. It is, however, frequently managed, and the increased ultimate strength values claimed for the so-called "semi-steel" are in a large measure due to their frequently low total-carbon content. Manipulation of the total-carbon content is, however, far better carried out in the air furnace or crucible furnace, and the high values obtained in electrically-melted iron are to be partially traced to their reduced total carbon content.

### Composition of Cast Iron for Automobile Castings.

The most important grey cast-iron castings used in the automobile industry are the components of the engine, the cylinder, cylinder liner, piston, and piston rings. Cast iron is employed in a few other parts; but it is proposed to confine the notes to these particular castings only.

*Engine Cylinders.*—Automobile engine cylinders can be divided into two separate classes, viz., air-cooled and water-cooled cylinders. In spite of the extended adoption of the composite method of construction of water-cooled cylinders on aircraft engines, the extension of this type of design to automobile engines has been very limited, and the monobloc water-cooled cylinder-casting must be taken still as the type of water-cooled automobile engine cylinder. As a general rule, cylinder castings, whether water-jacketed or not, are comparatively difficult castings to produce—a fact which may be ascribed to the intricacy of the design, the small thickness of metal and the high degree of accuracy required.

These features introduce numerous difficulties into the actual "founding" operations which are only overcome by the exercise of really meticulous care at every stage of production.

Considerable discussion has centred round the correct chemical composition of the cast iron to be used for automobile-engine cylinders. The two features to be borne in mind in deciding upon the composition are: (1) That it shall be designed to assist the foundryman in obtaining a satisfactory casting, and (2) to obtain the most superior product.

With regard to the former consideration the foundryman requires the most fluid metal having the ability to run successfully the intricate casting. The most satisfactory method of ensuring these qualities in the molten metal is to utilise extremely hot metal. This is the method to be desired, as it allows of the use of a metal having a lower phosphorus content than would otherwise be necessary—and, in addition, the high casting temperature tends to ensure a high tensile strength.

The limits of compositon laid down for water-cooled aircraft-engine cylinders by the British Engineering Standards Association, Specification K 12, are given in Table II.

TABLE II.—*British Engineering Standards Association Specifications for (B) Water-Cooled Aircraft-Engine Cylinders.*

| | A | B |
|---|---|---|
| | Per cent. | Per cent. |
| C.C. .. .. .. | 0.50—0.80 | 0.50—0.80 |
| Tot. C. .. .. | 2.70—3.50 | 2.70—3.30 |
| Silicon .. .. | 1.20—1.80 | 1.20—1.80 |
| Manganese .. .. | 0.80 [max. | 1.10 max. |
| Sulphur .. .. | 0.12 | 0.12 |
| Phosphorus .. | 0.35—0.80 | 0.60—1.2 |

The two alternative compositions are essentially different in the limits of manganese and phosphorus, and this may be ascribed to the uncertainty of the influence of these two constituents. It is also required that a ⅞ in. diam. test bar, sand cast, to either of the limits of composition specified shall give a minimum ultimate tensile strength of 12 tons per sq. in.

(*To be continued.*)

* Keller. J.I.S.I., 1919.

## Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

### Stainless Steels.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—We have read with some amount of interest the note appearing in your issue of the 11th inst. on some properties of stainless steel, with which we have had a certain amount of experience.

We agree entirely with your conclusion that no increased resistance to oxidation would be expected following a rise in the carbon content of the material above the usually accepted standard of about 0.30 per cent. In all probability within certain limits the ratio of chromium to carbon in the steel affects its resistance to oxidation. Our experience has been that low carbon stainless steel containing about 0.1 per cent. of carbon and known as "stainless iron," has, if anything, a superior power of resistance to attack by corroding agents than even the usual material commonly used for the manufacture of cutlery. In general, as far as we are aware, there seems little to justify assumptions made to the contrary.—Yours, etc.,

THE BRITISH THERMIT COMPANY, LIMITED.
W. L. Turner,
Governing Director.

The Albany, Liverpool,
August 15, 1921.

TRADING IN the style of Messrs. C. H. Hufton & Sons, Messrs. C. H. Hufton and E. H. Hufton, Sun Emery Mills, Alcester Street, Birmingham, manufacturers of emery and fluxes, have dissolved partnership.

XUM

# The Preparation of Enamels.

By Neville Deane.

In the manufacture of enamels there is one outstanding feature which must be constantly borne in mind, and that is, cleanliness is not merely a virtue, but a vital necessity throughout all the processes.

The mixing room should be cool, dry and free from dust and fumes. The enamel materials should be kept in wooden bins, with well-fitting wooden lids to exclude dust. Metal bins are of little use, since the chemicals might attack the metal, or rust and scale might be formed and mix with the enamels, causing a bad colour and endless trouble. Materials received in sacks should be emptied into the bins as early as possible to avoid contamination. Bins should be named, or numbered if secrecy is desired, in order to avoid mistakes being made.

In making up the mixtures the larger quantities may be weighed first, and the various materials heaped up in a large wooden bin. The mixer should stir the materials together himself, before the actual sieving and mixing. If made in large quantities mechanical mixing and sieving may be of advantage, but usually the mixture is sieved manually, using a wooden block to break down all lumps. Everything must pass through the sieve, and it is imperative that the mixing should be thorough, as otherwise difficulty will be encountered in the melting. Particular care must be taken that small quantities are well disseminated throughout the mass, such as cobalt oxide for colouring, or manganese dioxide for bleaching, as unless this is done much of their effect will be lost.

Whilst mixing, it should have been possible to raise the melting furnace to the proper temperature. For experimental purposes, or quantities up to about 10 lbs., a crucible and pot furnace should be used, but an average melt of 1 cwt. should be made in a special reverberatory furnace. This must be arranged so that the mixture is placed on a sloping hearth, separated from the firebox by a bridge, so that the flames will sweep over the heaped-up material and melt it, running it down the hearth into a bosh or crucible, at the base of which is the tap-hole. The tap-hole is plugged up before charging the furnace with a wad of pipe-clay wrapped in paper, and smeared over with more pipe-clay. This is easy to remove, and is not harmful to the enamel. In front of the furnace is a large tank, filled with clean water, into which the enamel flows when tapped out. This will quench and granulate the enamel to facilitate grinding. In the case of a crucible furnace for experimental work any fair-sized tank will do, even a large bucket, providing that it is quite clean.

The furnace having been prepared, the mixture is thrown through the charging door on to the hearth by means of a scoop. It must be thrown to the back of the furnace, and only in suitable quantities at a time. If the mixture is put in the wrong place or in too large quantities, it is liable to run over the bridge and into the firebox, instead of into the bosh.

If a crucible and pot-furnace are being used, then the empty crucible is placed in the fire and made hot, after which the mixture is charged, allowing one lot to melt before another is added. Care must be taken that no coke falls into the crucible whilst making up the fire, and it should be remembered that in melting soft enamels containing much alkali there is a risk of the crucible being eaten through if left too long. Similarly, the melting furnace requires relining periodically, owing to the fluxing of the bricks.

When the enamel has all been charged and has melted, the liquid mass should be vigorously stirred at intervals by means of an iron slice until it is seen, by means of a sample, to be in a suitable condition for tapping. The iron slice is dipped in the enamel, quickly withdrawn, and the enamel allowed to run on to an iron plate or shovel. When cold, it should be glossy, of good colour—not a dirty yellow or brown—and no specks of uncombined materials must be seen. A long thread is usually left hanging from the slice, and this should be of uniform thickness, smooth and free from knots. Experience is the best teacher as to when the enamel is ready for tapping out, but when this condition is attained there must be no delay.

The pipe-clay plug is easily removed, a shovel being held under the tap-hole to prevent pieces of clay from falling into the water. The enamel should flow smoothly into the water, the usual precautions being taken to keep the tap-hole clear, and the water must be kept in constant motion by means of the slice to prevent the enamel forming a solid mass on the bottom of the tank.

When the enamel is all out the tap-hole must be kept clear or else plugged up again with clay, so that it shall not be filled up by enamel draining from the furnace walls.

The water is run off from the tank, and the granulated enamel is put into a large barrel, carefully covered over, and left to drain, after which it is ready for grinding. For grinding an enamel to be applied as a powder a ball mill may be used, but for a swill enamel a revolving stone mill is to be preferred. In any case the enamel is put into the mill with any necessary additions, such as clay, tin-oxide, etc., and a sufficient quantity of water. It is most important that sufficient water is used, especially in a stone mill, as otherwise the enamel is not ground properly, takes a longer time, and may get heated and partly lose its gloss. The water used must be clean, and for the highest quality of enamels distilled water may be used. After being charged, the mill is set in motion, covered over to keep out the dust, and left till it is estimated that the enamel is ground sufficiently fine. It is then examined, and, if necessary, more water is added, and allowed to grind for a further period. When it is satisfactory, the enamel is run out into a bucket, or other receptacle, and allowed to stand and settle.

In the case of a "dust" enamel the water is poured off, and the wet mass dried rather slowly over a heated plate, with continual stirring to prevent the formation of lumps. It is then sieved into a dust-proof box to be used as required. Additions are, in some cases, made during the drying process to improve the colour.

If a swill enamel is being made, the water is drained away until only what is considered a sufficient quantity is left. Then, if clay has been added during the grinding, a little magnesium sulphate, or a chemical having a similar effect, is mixed in to make the enamel "hold up." It should then appear and feel like a thick batter, and when swilled or sprayed on to the work should "hold up" instead of running down to the lowest point. In this connection experience will soon indicate the correct condition.

The matte enamel is sintered in shallow pans in the muffle furnace, broken in pieces, and then ground with clay to use as a swill. Quartz, borax and other materials are often added in the grinding.

The matte is first brushed on to the cleaned articles, preferably sand-blasted, then swilled evenly all over very thinly and left to dry in a warm room, which must be free from dust. When quite dry, they are fired in the muffle in any suitable way, such as by being put on racks or placed in by a fork or a peel. The coat of matte should be well burned in, as on the success of the matte depends the finish of the enamel.

If a dust enamel is used the articles are withdrawn one at a time, and the enamel sieved on in such a way that it is put on evenly all over. Different methods are adopted for different varieties of work, as, for instance, rolling on wheels fixed to an iron table for all suitable goods, such as hollow-ware. After the dusting, the article is replaced in the muffle and fired. This is the most important operation, since if fired too long or at too high a temperature blisters will appear, which cannot be covered over subsequently.

When properly fired they are again withdrawn and dusted with enamel, this alternate dusting and firing being continued until a sufficient body

of enamel has been incorporated. The last coat may be fired at a slightly higher temperature to produce a highly glazed surface, but the articles must be closely watched and taken out immediately they are ready. They are then allowed to cool in the shop before being taken out into the cold air outside.

If a swill enamel is being used the goods are taken out after firing the coat of matte and allowed to cool. When quite cold, the enamel is brushed, swilled or sprayed on in a suitable manner, the idea being to get a thin even coating all over, and put in the drying room. It must be kept in mind that if a speck of carbonaceous matter, such as soot, is allowed to drop on the enamel and fired, then the carbon may reduce some tin-oxide and cause a permanent black mark on the work.

After drying the articles are fired, observing the same precautions as for the dust enamel, withdrawn, allowed to cool, and a second coat put on. The second coat may be thicker, and as a general occurrence two coats should be sufficient. If any enamel is splashed on where it is not required it may be brushed off when dry, before firing; and if borders or bands of different colours are required they may be applied and similarly burnt in, after which the enamelling is completed.

Dust enamel allows more latitude, both in applying and firing, but the swill enamel, if of suitable composition, gives better results, and is more economical, both in material and labour.

## Electric Vitreous Enamel Furnace.

A two-compartment electric furnace for baking vitreous enamel on resistance tubes has recently been installed at the Schenectady works of the American General Electric Company.

The furnace is divided by a door which can be raised or lowered when a batch of tubes is to be transferred from one compartment to the other. These tubes consist of a grooved porcelain body, wound with resistance wire; the enamel is placed over this winding. The front compartment of the furnace is used as a preheater where the tubes are held at a temperature of 297 deg. C. for six minutes. This is necessary, because if the body of the tube is subjected to too high an initial temperature it will crack. The connected load on this compartment is 9 kw., and the temperature is automatically controlled by means of a thermostat. When preheating is accomplished the work is moved into the second or baking compartment by raising the door between the two compartments. In this compartment it is subjected to a temperature of 900 deg. C. for six minutes, emerging from it in a finished state. The connected load in the compartment is 24 kw., and the temperature is also automatically controlled by means of a thermostat.

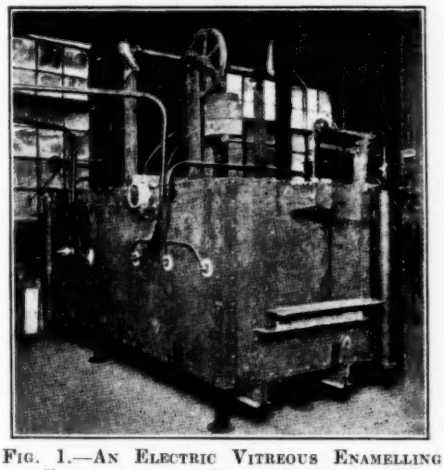

FIG. 1.—AN ELECTRIC VITREOUS ENAMELLING FURNACE WITH PREHEATING AND HIGH TEMPERATURE COMPARTMENT.

The heating units on both chambers are arranged so as to give a very even heat distribution, and, by using thermostats, an absolutely uniform temperature is obtained during the preheating and baking periods. This furnace also possesses the further advantage in that both operations—viz., preheating and baking—can be carried on at the same time on two different batches of work.

Each compartment will hold a tray containing thirty-six tubes which weigh about 27 lbs.; the tray weighs 30 lbs., so that there is a total load of 57 lbs. in each compartment. The dimensions of the compartments are 48 in. long, 18 in. wide, and 24 in. high, and the overall dimensions of the furnace are 13 × 5 × 7 ft. The heating equipments can be made for 230 volts direct current, or 220 volts single-phase alternating current.

This furnace has not only saved time and floor space, but has improved the quality of the finished product, and has reduced the percentage of defective tubes from 20 per cent. to less than 1 per cent.

Some interesting comparisons have been obtained with this furnace and an oil-fired furnace which it replaced. Working on two different classes of material—viz., push buttons and resistance tubes—it was found that the kw.-hr. per lb. of push buttons was 1.87, and the cost per lb. 0.115d. For resistance tubes the kw.-hr. per lb. was 0.541 and the cost per lb. 0.3d. The cost per hour of operating the oil furnace was 3s., since it consumed 6 gall. of oil costing 6d. per gall. The cost over the same period with electric heat was 1s. 8½d., or a saving of 1s. 3½d. per hour in favour of the electric. It is estimated that production has also been increased approximately 50 per cent. —"Chem. and Met. Eng.," Vol. 25, No. 5.

## Institution of British Foundrymen.

### LONDON BRANCH.

At a general meeting held on August 10 at Cannon Street Hotel, the following officers were elected for the 1921-1922 session:—President, Mr. H. O. Slater; Senior Vice-President, Mr. Wesley Lambert; Junior Vice-President, Mr. T. D. Robertson; Hon. Secretary, V. C. Faulkner. Delegates to the General Council, Messrs. A. R. Bartlett and Wesley Lambert. Council, Messrs. J. H. Gaskin, J. Hall, C. Cleaver, G. C. Pierce, B. W. Cooper, H. E. Hand, A. Bowman, H. A. Harford, E. R. Brown. *Ex-Officio* Members, Major D. Gordon and Messrs. A. R. Bartlett and A. Willis (as past-Presidents.

The retiring Secretary (Mr. A. Willis), in presenting his annual report, stated that the unsettled industrial conditions, coupled with high railway fares, had acted adversely on the attendance at the meetings during the past session; especially is this applicable to the London Branch, as the majority of the members live many miles from the centre of London. The cost of running the Branch for the last year was £54 15s. This would occasion the Council little difficulty if members paid their subscriptions more regularly. The total membership of the Branch is 135, made up of 75 full members, 54 Associate members, and only two Associates. During the year 31 new members have been elected, and 25 have been lost owing to transfers to other branches, resignations and deletions of names owing to the non-payment of subscriptions. There has thus been a gain of six members during the past year. This figure, according to the Secretary, could be largely increased if members would only make efforts to make the work of the Branch better known.

**AUSTRALIAN BRONZE WIRE REQUIREMENTS.**—The Deputy Postmaster-General, Brisbane, Queensland, invites tenders for the supply and delivery of:—8 tons 7 cwt. wire, bronze, 40 lbs. per mile; 11 tons 10 cwt. wire, bronze, 70 lbs. per mile. Tenders will be received in Brisbane up to October 5 next. Representation by a resident agent in Australia is essential. A copy of the general and special conditions, form of tender and specification can be seen by United Kingdom firms interested on application at the Department of Overseas Trade (Room 50a), 35, Old Queen Street, London, S.W.1. A second set of these documents is available for firms in the provinces unable to inspect the documents in London.

XUM

# Transport Improvements in a Remodelled Foundry.*

Making over a foundry to an efficient and harmonious whole out of a series of disconnected units where the area was limited because of city streets, was the problem faced by the engineers who remodelled the various buildings of the Murphy Ironworks, Detroit, manufacturers of Murphy automatic furnaces and Riley underfeed stokers. The works were constructed at widely separated intervals with no idea of co-ordination. The extension of the foundry, the installation of the yard crane, and the present systems of handling were completed about a year ago.

In the remodelled plant comparatively few handling units are used, the great bulk of the material being moved by two electric travelling cranes only, one in the yard and one in the foundry. According to Frank B. Bigelow, general manager, and George I. Bouton, chief engineer, both of whom were responsible for the changes, in one year from the installation of the yard crane alone the company had saved more than twice the cost of the crane, the runways and the entire expense of installation.

Coke, coal, pig iron, sand, etc., arrive in trucks to the siding between the foundry and machine shop buildings. This open space is covered by a 10-ton 3-motor Northern type E high-speed crane, 51 ft. span, designed to handle a clam-shell bucket, a lifting magnet, and to be used for general handling purposes. The bucket is electrically driven and has a capacity of 1 cub. yard. The lifting magnet, 45 in. dia., was manufactured by the Electric Controller and Manufacturing Company, Cleveland. The crane runway extends in one direction as far as the angle of the foundry containing the cupolas, and in the other direction it cantilevers over the street, permitting the crane to handle material from the tramway track at right angles to the yard track. An open landing platform, or dock, is at one end at the same level as the charging platform. This dock has a several days' storage capacity of raw material for the cupolas. A car of coke is shunted in and unloaded by the crane and bucket in 60 to 90 minutes. The coke for immediate consumption is placed on the dock and the remainder deposited in the coke storage bin, whence it may be transferred to the dock as required. The core-sand and limestone are handled in like manner, the former being placed in the core-sand storage bin, and the latter carried either directly to the dock or to the storage bin in the yard. For handling pig-iron, the lifting magnet is substituted for the bucket, the change requiring only two minutes. The iron is unloaded from the truck, 1,200 lbs. at a lift. An average truck can be unloaded in 30 minutes. The pig-iron is placed in various piles in the yard until the analysis can be checked, whence it is transferred as required to the dock. Scrap for melting is handled in a like manner. The coal for the power plant is moved by the crane and bucket, being discharged into a steel hopper situated above the railway track from which it descends by gravity to the coal storage pile contiguous to the boiler house. A truck of coal can be unloaded in 45 to 60 minutes.

From the dock the material is fed to the cupolas by narrow gauge tracks and charging boxes, and as each load passes through the door opening from the dock to the charging floor it is weighed by the scales at that point. An Otis electric elevator is situated in one corner of the charging room, to be used as an auxiliary for carrying material in case of any interruption to the service of the yard crane, or in case that crane is being used on other service.

The foundry, with a capacity of 50 to 60 tons per day, is 500 ft. long, with the main bay 56 ft. in width and the side bays 25 ft. wide. The main bay is served by a Northern 10-ton 4-motor type E electric crane with a 5-ton auxiliary hoist, and in the side bays over the moulding floors are several single girder cranes with electric hoists of 1- and 2-ton capacity. Two 84-in. Newten cupolas, made by the Northern Engineering Works, Detroit, melt the iron, and can be used together or alternately. The foundry is exceptionally light and airy, and is provided with an efficient heating and ventilating system, for which the Green Economiser Company furnished the blower and the heating unit. A locker room for employees is under the docks and is provided with shower baths and other lavatory equipment.

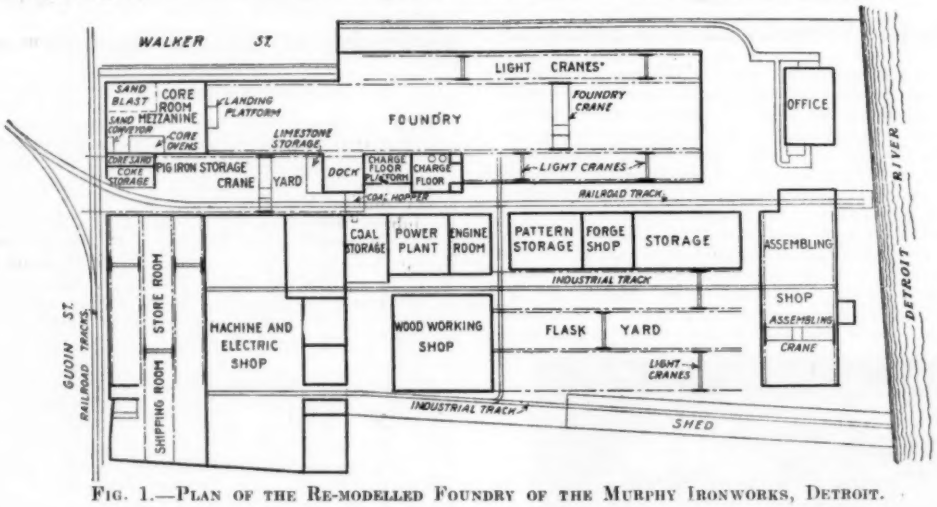


FIG. 1.—PLAN OF THE RE-MODELLED FOUNDRY OF THE MURPHY IRONWORKS, DETROIT.

At the north end of the foundry is a mezzanine floor upon which are placed the core room and the core ovens. The core sand is carried from the outside storage bin to mezzanine level by an electric-driven conveyor built to a special design by the Murphy Ironworks. The mezzanine floor is furnished with a landing platform so that the foundry crane can place on or remove any material from the mezzanine floor to the foundry floor.

Below the mezzanine on the main floor level is placed a battery of electric-driven steel tumbling barrels, built by the Sly Manufacturing Company, and also Mott sand-blast equipment with its ventilating system, overhead tracks, etc.

The cores are baked on racks moved about on the core-room floor by Barrett lifting trucks. When removed from the ovens, the racks are wheeled to the landing platform, where they are picked up by the foundry crane and distributed to various parts of the foundry.

The iron is poured from the cupolas into a reservoir ladle on wheels suitable for being moved in between the two cupola spouts. From the reservoir ladle it is received by the crane in a crane ladle and carried to a certain station in the foundry where the crane ladle is deposited in a special floor ladle truck with flat wheels, which makes it possible to move the floor ladle from place to place. There are several of these floor ladle trucks at different points in the foundry, and the

* Extracted from the "Iron Age."

function of the crane while pouring, is to deposit full ladles on the trucks at various points and take back the empty ladles for refilling. From the floor ladles the iron is distributed to the moulds by hand ladles, although in the case of large moulds it is sometimes poured direct from the crane. With this system the one crane can take care of the entire foundry while pouring, as its function is principally to keep the floor ladles supplied with hot metal. The use of a standard overhead travelling crane for primary distribution to small ladles is interesting as compared with the usual mono-rail distributions.

In shaking out, the castings are collected in boxes and carried by the crane directly to the tumbling mills at the north end of the foundry. Sprues and risers are also carefully tumbled to free from sand before being returned to the cupola.

After the castings are tumbled or treated by the sand blast, they are carried in trucks on a narrow gauge track to the machine shop, where they are handled by small cranes or overhead tracks. The small units are assembled in a shop adjacent to the machine shop, but the large units are carried through various stages to the main assembling shop, where they are handled by a 7½-ton Northern 3-motor crane, 44 ft. span. The railway track also runs into this shop, and the large units are loaded by the crane and dispatched from this shop.

## Genelite.

A new bearing material, called Genelite, recently developed in the laboratory of the American General Electric Company, has given remarkable results in a series of tests made to determine its performance, both when lubricated and self-lubricating.

It consists of a mechanical mixture of a high-grade "synthetic" bronze, and graphite, the latter amounting to about 40 per cent. by volume of the whole mass. Since the material cannot be melted and poured into moulds like ordinary metals, its formation into bearings is accomplished by a special process. It is made from the oxides of tin, lead and copper (mixed in the proportions to form a high-grade bronze) plus graphite, all the ingredients being in a finely divided state. Graphite is added in sufficient excess quantity to reduce the oxides to the metals and still leave the required content in the finished material. The oxides are partly reduced by heating the mixture, after which it is still in powdered form, but is then pressed as nearly as possible to the required shape in massive metal moulds.

In the pressed form it is still too brittle to stand handling, so it is given a final heat-treat-

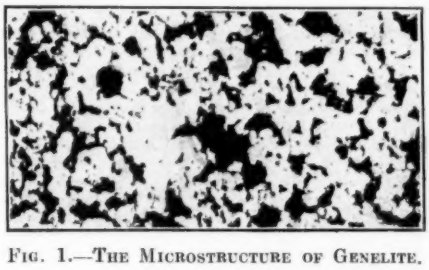

FIG. 1.—THE MICROSTRUCTURE OF GENELITE.

ment which reduces and sinters the metals together into a homogeneous bronze, holding the graphite uniformly distributed throughout the mass. The evenness of this distribution is shown in Fig. 1, at 100 diameters. The white spots are the bronze, and the black ones the graphite. The baking fixes the graphite so securely within the mass that it cannot be separated or washed out, even if the metal is lubricated. Some of the various stages of manufacture are shown in Fig. 2, in which substance number 5 is the mixture after the preliminary bake, ready for pressing, 6 a bushing pressed from the powder, 7 a bushing after the final bake (or Genelite in the raw stock form) and 8 a finished piece. The material has the general appearance and body of bronze, but the characteristics are different. It does not machine readily by ordinary methods, but can easily be ground, which has been found to be the best method of handling it in production. Neither has it the physical characteristics of bronze, having very low tensile strength, but being capable to withstand high compressive strains.

Another marked difference is its porosity, it

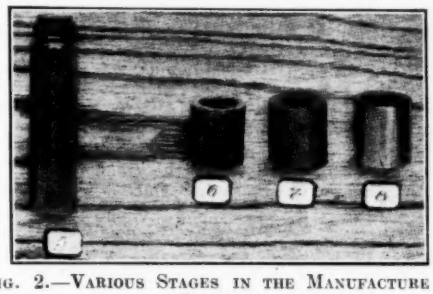

FIG. 2.—VARIOUS STAGES IN THE MANUFACTURE OF GENELITE.

being able to absorb as much as 2½ per cent. by weight of oil. This feature is made use of in some of the high-speed applications where oil is applied to the outside of the bushing and carried to the bearing surface by capillary attraction.

The tests have brought out another valuable characteristic, from the user's standpoint, in that a bearing made from this material never seizes or "freezes," as these expressions are commonly understood. The metal of the shaft and bearing never flow and weld together as a result of bearing friction. If the Genelite bearing sticks, owing to having been fitted too closely, examination will show that no damage has been done, either to the bearing or the shaft, and they can be reassembled after the bearing has been ground down to proper size.

One of the principal uses of Genelite is on various parts of automobile engines where lubrication is either poor or neglected altogether owing to the inaccessibility of the bearing. Places where its self-lubricating properties render it valuable are on fan bushings, clutch centreing bushings, throttle control bushings, etc. Places where lubrication is apt to be poor owing to dilution of the oil by uncombusted fuel products or other cause are also helped by the installation of Genelite bearings.—"Chem. and Met. Eng.," Vol. 25, No. 5

## The "Rapid" Electro-Magnetic Separator.

The question of removing iron and steel from moulding sands has received but scant attention in this country. The Rapid Magnetting Machine Company Ltd., of Magnet Works, Lombard Street, Birmingham, has made a special study of this subject and has designed and placed upon the market, two types of machine, the one for dealing with rough material, whilst the other tackles the finer grades of material. This latter type, which is suitable for treating foundry sands is shown in Fig. 1 and consists of a powerful electro magnetic drum over which travels a flexible belt studded with a number of conical feeders, which become magnetic when passing over the drum. Naturally the introduction of "studs" renders the apparatus much more efficient as it concen-

FIG. 1.—THE RAPID MAGNETIC SEPARATOR.

trates the lines of force in a very suitable manner and increases the efficiency of the magnetic field. The apparatus is made in three sizes, the smallest having a drum 12 inches wide and the largest 24. In the ordinary way a nine foot endless belt is used. The sand is fed on to the belt and on reaching the magnetic drum, the non-magnetic material pulls in front by gravity whilst the iron or steel is carried to the back falling off at a point where the belt leaves the drum.

XUM

# Burning-On.

By JOSEPH HORNER.

Burning-on is justifiable when done on some portion of a casting that is not a vital part, and in sections that are subject to moderate stresses only it may be allowed to pass if there is ample margin of safety. It should not be permitted in parts subject to tensile stress, nor to severe bending. Some may remember that at the inquiry into the failure of the Tay Bridge evidence was given that many imperfect lugs had been made good by burning-on. Being in tension, and forming as they did the attachments for the bracing bars, they contributed to the disaster. Only when lugs are

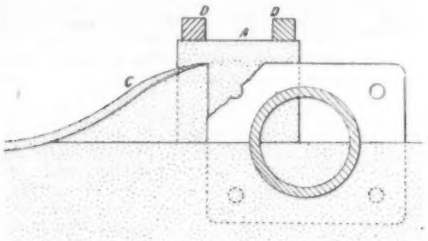


FIG. 1.—SECTION OF THE ARRANGEMENT FOR BURNING-ON A CORNER OF A FRACTURED FLANGE.

subjected to moderate stress, as when they form attachments for secondary details, is burning-on justifiable. In general, the practice is permissible if the corner of a column flange is broken, or if a piece has been knocked off one side of a flange, or if there is a big blow-hole in a part subject to compressive stress, or if a mould does not run-up properly, or if the tip of a propeller blade has been broken off. Apart from the chance of imperfect union occurring, there is always the risk of the casting being cracked during the process, the reason for which will be apparent from the nature of the work. Into this the personal element enters, since some workmen are now more adept at it than others.

In order to render this operation successful, it is necessary that the surfaces in contact be both raised to the melting point and that they shall be perfectly clean. The fractured surface is cleaned with the chipping chisel, after which the casting is warmed throughout, and embedded in sand to receive the supplementary metal required. Suc-

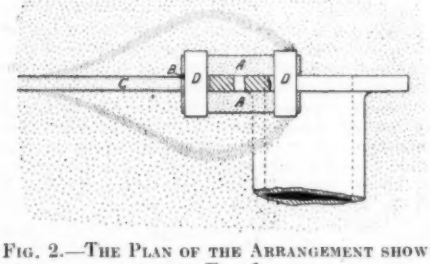


FIG. 2.—THE PLAN OF THE ARRANGEMENT SHOWN IN FIG. 1.

cess depends mainly on the quantity of metal poured. Obviously, it is not sufficient to pour just the few pounds needed, since that would not raise the cold casting to the fusing point locally, while the molten metal would be simply chilled. The art consists, therefore, in pouring a constant stream over the broken part until the latter is raised to the fusing point. This stage is tested by the moulder pushing the point of a rod into it, just as a smith does that of a weld joint, to judge when it has reached the pasty condition. It is safer to pour an excess of metal than barely enough. To burn-on a few pounds only, from 4 to 6 cwt. will have to be poured, the excess running away through a channel provided for the purpose.

The rig-up for burning-on must take account of these facts. Figs. 1 and 2 are illustrations of burning a corner on a flange fractured through a bolt hole, in section above and plan below. The column is bedded in the sand of the floor, level with its centre. Three flat pieces of loam cake, A, A, B are laid against the flange, B being of the flange thickness. A, A are carried well above the top edge of the flange, and B is level with the edge, and conducts to the flow-off channel C. Weights D laid on the loam cake prevent it from shifting, in addition to which a body of sand is rammed around as shown, to confine the loam cakes laterally, and prevent metal from getting

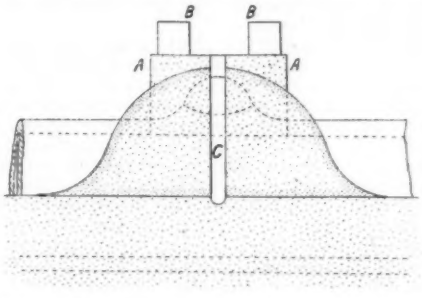


FIG. 3.—SECTION OF AN ARRANGEMENT FOR BURNING-ON A LUG.

away anywhere except through the gutter C. There is no runner, but the metal is poured directly into the broken gap, and allowed to run away until that in the broken part of the flange has become fused.

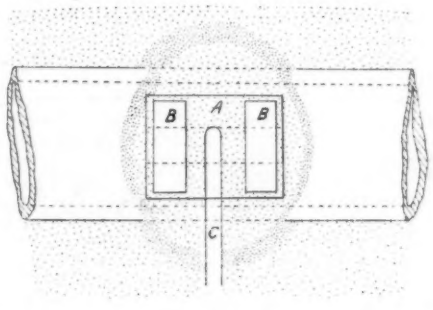


FIG. 4.—PLAN OF THE ARRANGEMENT SHOWN IN FIG. 3.

Figs. 3 to 5 show the rig-up for burning-on a lug. Pieces of dried loam cake, A, A, filed to fit the column, are laid against the faces of the lug, and one piece has the outline of the lug filed in it. They are held down with weights, B, B, and sand is rammed against their flanks. A gutter is

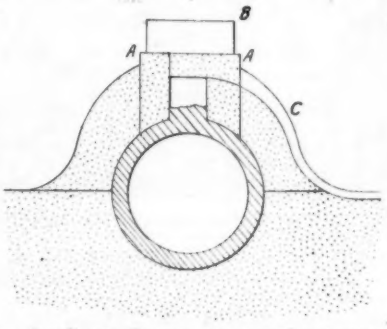


FIG. 5.—CROSS SECTION OF THE ARRANGEMENTS SHOWN IN FIGS. 3 AND 4.

cut at C for the metal to flow away through the metal being poured directly into the lug. It is poured very hot, and very slowly.

The rig-up for this work varies with different castings, but the methods are similar. The casting in the vicinity is rough, and rather hard, and requires a little dressing. But the difference in the cost and that of a new casting is considerable. Loam is used because it will stand the prolonged erosion of the metal better than green sand. Gunmetal can be treated thus as well as cast iron.

XUM

# Trade Talk.

THE shipments of pig-iron from the port of Middlesbrough during July amounted to 5,240 tons, compared with 10,197 tons in June.

MESSRS. MELDRUMS, LIMITED, Timperley, near Manchester, are supplying the Kilmarnock gas works with sprinkler stokers with forced-draught furnaces for two Lancashire boilers.

IT IS REPORTED that Messrs. Clayton Wagons, Limited, Lincoln, have received an order for 250 four-wheeled tipping wagons required for the Bombay Back Bay Reclamation Scheme.

THE GREAT CENTRAL RAILWAY COMPANY has recently completed a number of a new class of powerful four-cylinder express goods and mixed traffic engines from which great economies will be derived.

A STEEL REFINING WORKS at the Yien Poo Tan, Pootung, is to be constructed by Mr. Lu, a Shanghai merchant, as soon as he has raised the necessary capital.

THE ABERCARN (MON.) TINPLATE WORKS, closed during the whole of this year owing to trade depression, reopened last week, and will find employment for between 400 and 500 men.

A SHIPMENT of 50 cast-iron lamp standards by the John East Iron Works, of Saskatoon, to Regina, to be placed on the Parliament building grounds, is claimed to be the first order of this nature to be placed west of Winnipeg.

IT IS ESTIMATED that the loss in wages caused by the ship joiners' strike at Southampton, which has just been settled, amounts to nearly a million pounds. A valuable Admiralty contract for the reconditioning of several troopships was lost to the port last month.

DISCHARGING NEARLY 1,000 MEN when they closed down their export department in February, Messrs John Lysaght, Limited, of Bristol, reopened this department last week with 500 men.

IT IS REPORTED that a number of sheet mills in the Tipton district, which have been idle for twelve months, are shortly to be re-started. Earl Dudley's Round Oak Iron and Steel Works, employing some 2,000 hands, have resumed operations.

THE INSTITUTION OF MINING AND METALLURGY has moved to its new premises, Cleveland House, City Road, E.C.1. The Institution of Mining Engineers has also moved to City Road, and Mr. C. McDermid has assumed the secretaryship of both societies.

IT HAS NOW BEEN DECIDED to re-start the Devonshire works of the Staveley Coal and Iron Company, Limited. Negotiations concluded with the National Amalgamated Union of Labour enable production costs to be brought down to a figure which justifies the re-starting of two of the three blast furnaces and 100 of the 150 coke ovens.

ONE of the furnaces at Millom, belonging to the Millom and Askam Hematite Iron Company, is to be started as early as practicable. The employés will be on short time, but efforts will be made by the management to divide the work amongst the men. These furnaces have been standing idle since the first week in April.

A PORTSMOUTH REPORT states that several thousand workmen in Government establishments will be affected by proposals to be considered by the Miscellaneous Trades Joint Council, for the reduction in rates of pay of those classes of miscellaneous labour whose wages have not been affected by reductions enforced in particular trades or industries.

"ONE SEVENTH of our customers in world trade are dead, and new markets do not exist at present to take their place. A percentage of our population, therefore, must either find new employment or emigrate." This statement forms part of the report issued by the Empire Development Parliamentary Committee, which embraces more than 200 Coalition M.P.s.

THE ANNUAL REPORT of the Shipconstructors' and Shipwrights' Association complains that there are too many in the trade union movement who can do nothing but criticise; who are destructive, not constructive; who are more concerned about baiting their executives and officers than about anything which will be of real benefit to the industrial classes.

IT IS REPORTED that the fitters, turners, etc., in the employ of Messrs. Guest, Keen & Nettlefolds, at the Dowlais Works, Cardiff, who prior to the dispute at the works and the slump in trade were paid £6 a week, have now accepted a reduction of 30s. per week, to be followed by a further "cut" of 5s. later on. The workers were offered and refused the same rate last February.

THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION, to be held at Olympia from September 7 to 28, the promoters state, will be noteworthy in that it will include many firms who have not previously shown in public, while a record will be created by the large number of British inventions. All the institutions devoted to shipbuilding and engineering generally are associated with the exhibition.

AT A MEETING of representatives of the various Scottish Trade Boards, held recently in Glasgow—Mr. John Campbell, of Messrs. Pettigrew & Stephens, presiding—it was decided to appoint a Consultative Council of the representatives on all the Scottish Trade Boards to take such steps as may be necessary to protect the interests of employers whose conditions of business are regulated by Trade Boards.

SYSTEMATIC investigation of the possibilities of applying an electric smelting process in the commercial development of the titaniferous iron sand areas of New Zealand was undertaken some two years ago by Thomas Summerson & Sons, Limited, and exhaustive experiments have been carried out at its Darlington Works simultaneously with a thorough examination of local conditions and requirements in New Zealand by its representative, Mr. P. Leggatt.

IT is reported that Armstrong-Whitworth (Walker Yard), Cammell Laird (Birkenhead), John Brown & Company (Clydebank), and the Fairfield Shipbuilding Company (Clyde) are to receive the orders for the new super-Hoods for the British Admiralty. Eight new capital ships are to be laid down next year for the British Navy, with 16 in. and 18 in. guns. They will be 1,000 ft. long, and will steam about 30 knots. It is estimated that each will cost about £7,500,000.

ASKED BY SIR J. NORTON-GRIFFITHS whether the Disposal Board are quoting £1,200 to £1,300 for Baldwin's narrow-gauge locomotives, and whether new ones are being offered by the trade at £850 to £950, Mr. Hilton Young, in a written reply, states the Disposal Board were not now quoting the figures mentioned. The locomotives had been extensively advertised, but no inquiries had recently been received for them. He was not aware that new locomotives were now being offered by the trade at £850 to £950.

IN the mess room at the works at Bilston, on the 6th inst., the employés of the iron and steel works of Alfred Hickman, Limited, presented a pair of silver gilt wine coolers and an illuminated album to Mr. Edward Hickman, the retiring chairman of the firm. Two silver entrée dishes were also presented to Mrs. Hickman. Over £400 had been subscribed by 2,339 employés. After replying in thanks, Mr. Hickman asked the meeting to accept a framed portrait of himself and a pair of stag's head wall trophies, to be placed in the mess room.

THE DIRECTORS of A. Harper, Sons, & Bean, Limited, engineers, ironfounders, and stampers, of Dudley, have drawn up a scheme of arrangement which is to be submitted to the creditors of the company, and the object of which is to give the company an opportunity during the next two years to put the business on a satisfactory basis, and at the same time to secure to the creditors the payment of the debts due to them. Provision is made under the scheme for payment in full of all unsecured creditors to whom the company is indebted in a sum not exceeding £25.

THE DIRECTORS of the Sheffield Forge and Rolling Mills Company, Limited, are unable to present a report and balance-sheet as at June 30, 1921, to the annual meeting to be held to-day, August 25, 1921, as a settlement has not yet been arrived at with the taxation authorities. They are, however, satisfied that the circumstances justify them in recommending the declaration of a dividend of 10 per cent. for the year, payable, less income-tax. The shares allotted during the past year rank for a proportion only of this dividend, in accordance with the terms upon which they were issued.

THE SHIPYARD joiners' strike has been settled, and the men are resuming work this week. An arrangement has been come to between the Shipbuilders' Federation and the Executive Council of the Joiners' Society, under which there will be an immediate reduction in wages of 6s. a week, and one of 3s. in October. In December another 3s. reduction will be considered, along with other matters. The strike, which has lasted since the beginning of December, had its origin in the proposed withdrawal of the 12s. a week bonus, granted in the spring of last year, at a time when there was a big demand for joiners' labour. Carpenters and joiners in the Belfast shipyards did not take part in the dispute, having accepted the wage reduction.

MESSRS. YARROW & COMPANY, LIMITED, who formerly occupied extensive works at Poplar, have posted the following notice up in their works on the Clyde:—"Owing to repeated strikes, reduction of output, and demarcation disputes which have taken place in various industries throughout the country, the cost of shipbuliding has become excessive, in addition to which it is impossible to promise dates of delivery. With the greatest regret we have therefore decided temporarily to close our works, with the exception of our experimental and research department, on or about November 30. We shall reopen when conditions enable business to be carried on with some chance of success. We give this early notice of our decision so that our employés may have every opportunity to obtain work elsewhere."

XUM

# IRON AND STEEL MARKETS.

## Pig-iron.

The past week's movements in the pig-iron trade have been altogether uneventful, markets remaining completely idle, due in partial measure to holiday reasons, but perhaps more in consequence of an almost total absence of demand on consumer's account. The small amount of business recorded indicates clearly the continued uncertainty of the position in relation to fuel costs of pig-iron makers, and although coal prices are distinctly on the down-grade, no definite minimum has yet been reached which would afford a profitable basis for a general resumption of furnace production. A movement in this direction cannot, however, be long delayed, but until coke values are reduced to something approaching normal levels iron-masters will continue to mark time. In the meantime, more furnaces are going into action in the various centres of the smelting industry, but the number is still limited, and outputs are mostly designed for consumption in the owners' own steel works. The Cleveland iron market having been virtually closed last week, as customary for the local race meeting, no attempt was made to do actual business, while there are at present very limited supplies in stock available for disposal, notably No. 1 and silicious qualities. The general opinion in market circles is that prices must eventually come down to more reasonable figures. Current rates now ruling:—No. 3 Cleveland G.M.B. combined with No. 4 foundry selling at 132s. 6d To those who require only No. 3 the price is 135s., but No. 4 foundry has been reduced to 130s., and in both cases it is quoted for export at the home price, the 5s. export premium having been abolished. There is, of course, no demand from abroad, and, indeed, local consumers are still importing iron from abroad. Luxemburg basic iron having been sold, c.i.f., at 85s. per ton. Even our lowest grades cannot compete with such figures as these, and there need be little wonder that there are few buyers of No. 4 forge mottled or white iron, which are quoted 117s 6d., 117s. 6d., and 115s. per ton respectively.

East Coast hematite shows a rather stronger tendency. The home price is unchanged at 160s. for mixed numbers, and 162s. 6d. for No. 1, but makers have so well sold that they are less inclined to cut prices for foreign orders, and quote the same figure for export. In Cumberland and North Lancashire there is a more hopeful tone in the hematite pig-iron trade, and although anything like a sudden development into activity is not expected by any means, the fact that three furnaces are now in blast is reassuring. There is a better inquiry from steel makers, but nevertheless an official alteration in the price per ton for mixed Bessemer numbers is notified, which is now at £8 5s., delivered at Sheffield.

## Finished Iron.

There is very little fresh to report in the situation of the finished iron trade of the country, and perhaps, with the exception of the marked-bar section, business has been phenomenally quiet during the present quarter. Some revival of demand is, however, hoped for as the next quarterly meeting approaches, but the outlook must be regarded as most uncertain in the face of increased competition by Continental producers. For example, last week Belgian shippers were offering bars to the nut and bolt trade at £9 10s., delivered in Staffordshire, without getting more than a very poor response, for mills are already well bought, and find it as difficult as ever to get new orders. Last month there were imported 7,338 tons of bar iron and kindred material from Belgium, bringing the total for the current year up to 70,712 tons, value £1,099,100 On the other hand, our July exports under the same head amounted to no more than 648 tons. This is less than one-tenth of the export a year ago, and one-twentieth of that in July, 1913. Whereas our exports of this material produced £201,336 in July, 1920, their value last month was £20,782. Seeing that in the meantime marked bars have fallen from £33 10s to £20, and that unmarked bars are quoted to-day at £16, against £30 10s., it is obvious that our exports are now confined to the best qualities of iron.

## Tinplates.

Although several of the South Wales mills are again in operation, business in the tinplate market evidences little sign of recovery, and notwithstanding a good volume of inquiries from India and the Far and Near East, few actual transactions have been reported. Some makers say they see no prospect of a restart for several weeks, while the mills that are in operation do not represent more than 30 per cent. of the total tinplate trade capacity. Quotations have been round 23s. basis for cokes, net, f.o.t. The spot price ranges round 24s. to 24s. 6d., but there is very little doing, buyers holding off as much as possible in anticipation of still lower figures. Wasters are only in moderate request. CW, 14 x 20, have been sold at 19s.; CW, 28 x 20, at 38s.; and CW, 14 x 18¾, at 16s., all net, f.o.t. There has been a little inquiry for terneplates, a small business resulting. 23s. is being quoted for October onwards for usual specifications, net cash, f.o.t.

## Steel.

So far nothing has yet transpired to justify the more optimistic impression prevailing with regard to the future of the home steel trade, so freely expressed of late, new business for the present continuing deplorably slow. On the contrary, the depression in Sheffield commercial circles tends to deepen, as the months pass by without realisation of the anticipated improvement, and though it is quite feasible that some partial revival may be possible at the end of the quarter, there is for the moment no very convincing evidence of any tendency in that direction. General satisfaction is, however, expressed in Yorkshire that the contracts placed by the Government for the new battleships will provide a substantial amount of work in almost every department of the steel trade, of which a very fair proportion will come to Sheffield firms. Inquiries on overseas' account are still lamentably below the average, and although there must be an enormous shortage of steel products throughout the world, exchange and other financial difficulties preclude any expansion of immediate demands. Another ominous feature of the position is the increasing number of orders for rails going abroad, while imports of this class of material during July amounted to 604 tons of grooved rails for trams, and no less than 3,620 tons for railway track, the value being £47,834. Some activity is reported in the demand for steel castings, but steel rolling mill charges have been reduced 7½ per cent., and the cost for tilting and forging by 10 per cent. Values have been officially reduced by £1, and boiler plates by £2.

## Metals.

**Copper.**—Messrs. Henry Bath & Son Limited, in their fortnightly metal report, write, under date August 16:—Since our last report, movements in this market have been very small and trading of meagre dimensions. There is no improvement to report in home consumption, and consumers are still able to fill a considerable portion of their requirements with scrap. The week's markets opened with a further decline in prices, American advices continuing unfavourable, while home consumption demands were again on a limited scale. Refined sorts fell 10s. Closing prices:—Cash, Wednesday, £68 2s. 6d.; Thursday, £67 5s.; Friday, £67 2s. 6d.; Monday, £66 5s.; Tuesday, £66. Three Months.—Wednesday, £68 12s. 6d.; Thursday, £67 15s.; Friday, £67 12s. 6d.; Monday, £66 15s.; Tuesday, £66 15s.

**Tin.**—Firmer Eastern advices had a favourable effect upon the opening of the weeks' markets for this metal, business having been reported in a Singapore late cable as done in substantial volume at £156 10s. c.i.f. August dates realised £152 5s.; September sold at £152 10s. up to £153; October, £154. English ingots were quoted nominally £151, showing no change from Friday. Closing prices:—Cash: Wednesday, £151 10s.; Thursday, £151 10s.; Friday, £152 7s. 6d.; Monday, £152 10s.; Tuesday, £152 2s. 6d. Three Months: Wednesday, £162 10s.; Thursday, £163; Friday, £154; Monday, £154 5s.; Tuesday, £153 15s.

**Spelter.**—The week's markets opened unchanged, the demand continuing inactive, with, if anything, a decrease for home consumption. Only limited sales were effected, with September buying at £24 15s. and £25 12s. 6d. Closing prices:—Wednesday, £25 2s. 6d.; Thursday, £24 7s. 6d.; Friday, £24 17s. 6d.; Monday, £24 17s. 6d.; Tuesday, £24 15s.

**Lead.**—During the past week prices of pig-lead yielded very little ground, but at Monday's opening market offers came more freely, and prices for both near and forward delivery declined 5s. Business comprised August at £23 5s. and £23 2s. 6d.; September, £23; November and December, £22 12s. 6d. English lead is down at £24 5s. English closing prices:—Wednesday, £24 15s.; Thursday, £24 15s.; Friday, £24 15s.; Monday, £24 5s.; Tuesday, £24 5s.

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## Gazette.

Trading as the Farnham & Whyte Machine Company, Messrs. R. V. Farnham and R. J. W. Whyte, Linwood, engineers, have dissolved partnership. Debts by Mr. R. J. W. Whyte, who continues the business.

Mr. David Russell, trading as D. Russell & Company, Suffolk House, 5, Laurence Pountney Hill, E.C., iron and steel merchant, has been adjudicated bankrupt. Examination, Bankruptcy Court, September 6, at 11.

Mr. Gilbert Saunders, trading as Robert Saunders, Bay House, Pattingham, and Doctor's Piece, Willenhall, lock manufacturer and brassfounder, has been adjudicated bankrupt. Examination, County Court, Wolverhampton, October 5, at 2.30.

Trading in the style of Robinson, Nelson & Company, Messrs. A. E. Robinson and W. J. Nelson, 378, City Road, Manchester, laboratory furnishers, have dissolved partnership. Debts by Mr. A. E. Robinson, who continues the business.

Trading in the style of the Kilburn Magneto and Engineering Company, Messrs. F. Giladjian and E. J. Lord, 238, High Road, Brondesbury, electric magneto and general engineers, have dissolved partnership. Debts by E. J. Lord.

Trading in the style of Jones & Stewart, Messrs. A. D. Jones and J. N. Stewart, 59, Robertson Street, Glasgow, engineering agents and merchants, have dissolved partnership. Debts by Mr. A. D. Jones, who continues the business.

Trading in the style of W. Potts, Son and Corsair, Messrs. W. Potts, W. Potts, junr., and J. Corsair, Nutsford Vale Foundry, Pink Bank Lane, West Gorton, Manchester, iron founders, have dissolved partnership. Debts by W. Potts and W. Potts, junr., who continue the business as W. Potts & Son.

Trading in the style of Strachan, Jas., & Company, C. Strachan and R. Strachan, Coatbridge, iron merchants, have dissolved partnership. All debts due to the firm should be paid to either of the partners, who will discharge the whole debts and liabilities of the firm.

Mr. J. A. Greenway and Mr. W. A. Greenway, carrying on business at 7, Broad Street, Birmingham, as Greenway Brothers, machine tool makers, are paying a first and final dividend of 3s. 9½d. in the £. In the separate estate of Mr. J. A. Greenway a first and final of 4½d. in the £ is being paid.

## Company News.

**Dunstan Steel Corporation, Limited.**—Capital £5,000 in £1 shares. Registered office: Carlton Buildings, 35, Paradise Street, Birmingham.

**Thomas Spittle, Limited.** — Capital £35,000 in £1 shares, to carry on the business of iron founding. Registered office: Cambrian Foundry, Newport, Mon.

**Gardiner, Barugh & Jones, Limited.**—Capital £35,000 in £1 shares, to carry on the business of iron merchants. Registered office: 28 and 29, Waterhouse Lane, Hull.

**Robert L. Priestley, Limited.**—Capital £6,000 in £1 shares, to carry on business as boiler makers, marine and general engineers, etc. Registered office: Albion Parade, Gravesend.

**Wernavon Wagon Company, Limited.**—Capital £5,000 in £1 shares, to carry on business as general merchants, exporters, importers, manufacturers and repairers of and dealers in railway carriages and wagons, etc.

**Parsonage & Brookes (Birmingham).**—Capital £500 in 10s. shares, to carry on the business of manufacturers and dealers in springs and spring washers, engineers, founders, etc. Registered office: Lincoln Works, Lincoln Street, Wolverhampton.

**Lawson, Walton & Company, Limited.**—Capital, £3,000 in £1 shares. To take over the business of manufacturers, merchants, factors, importers, and agents for all foundry and engineering plant, etc. carried on by F. Sanderson and S. S. Walton, at 2, St. Nicholas Buildings, Newcastle, as Lawson, Walton & Company. Registered office: 2, St. Nicholas' Buildings.


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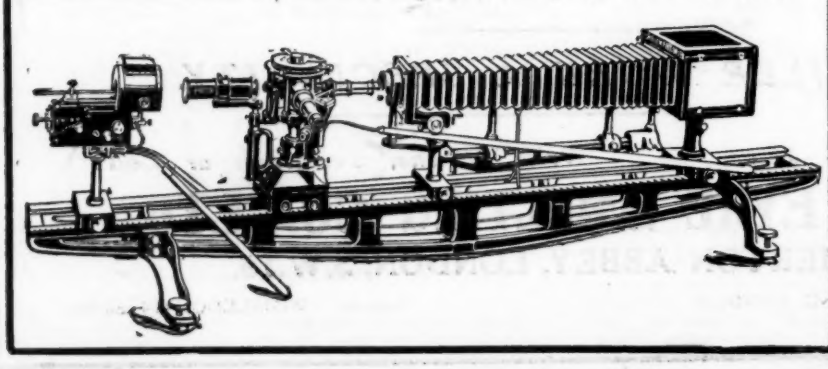

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